

 <p>United States Environmental Protection Agency Washington, DC 20460</p> <p>Interagency Agreement/ Amendment</p> <p>Part 1 - General Information</p>		1. EPA IA Identification Number DW-14-95822901 - 0		2. Funding Location by Region EPA R5					
		3. Other Agency IA ID Number (if known)		4. Awarding Office IASSC West					
		5. Type of Action New		6. IA Specialist: Yvette Downs 206-553-6321 Downs.Yvette@epa.gov					
7. Name and Address of EPA Organization US Environmental Protection Agency IASSC West 1200 Sixth Avenue, Suite 900, OMP-145 Seattle, WA 98101			8. Name and Address of Other Agency Department of the Interior Great Lakes Science Center USGS Great Lakes Science Center / 1451 Green Road Ann Arbor, MI 48105						
9. DUNS: 029128894		10. BETC: DISB		11. DUNS: 161182266					
12. BETC: COLL									
13. Project Title and Description Great Lakes Restoration Initiative implementation and measurement by USGS Pursuant to the Department of Defense Appropriations Act, 2012, Public Law 12-74 EPA is providing resources to United States Geological Service (USGS) to implement strategic priority actions and activities within their respective statutory authorities to measurably advance the goals of the Great Lakes Restoration Initiative Action Plan. Among other activities, USGS will under take a number of activities to restore and protect the Great Lakes ecosystem through: assessments of conditions and results of GLRI project implementations in Areas of Concern, embankments, river mouths and targeted watershed; application of science for controlling invasives, nutrients and botulism.									
14. EPA Project Officer (Name, Address, Telephone Number) Judy Beck 77 West Jackson Blvd. (G-17-J) Chicago, IL 60604-3507 312-353-3849 E-Mail: Beck.Judy@epamail.epa.gov FAX:			15. Other Agency Project Officer (Name, Address, Telephone) Norman G. Grannemann USGS Great Lakes Science Center / 1451 Green Road Ann Arbor, MI 48105 517-887-8936 E-Mail: nggranne@usgs.gov FAX: 517-887-8937						
16. Project Period: 06/06/2012 to 09/30/2016			17. Budget Period: 06/06/2012 to 09/30/2016						
18. Scope of Work (See Attachment) Scope of Work Attached.									
19. Employer/Tax ID No. 520852695		20. CAGE No: 347A4		21. ALC: 68-01-0727					
22. Statutory Authority for Transfer of Funds and Interagency Agreement Clean Water Act: Sec. 104(b)(2); Consolidated Appropriations Act, 2012; Public Law 112-74					23. Other Agency Type Federal Agency				
24. Revise Reimbursable Funds and Direct Fund Cites (only complete if applicable)									
	Previous Funding		This Action		Amended Total				
Revise Reimbursable (in-house)					0				
Direct Fund Cite (contractor)					0				
Total					0				
	Previous Amount		Amount This Action		Total Amount				
25. EPA Amount			\$12,431,961		\$12,431,961				
26. EPA In-Kind Amount					\$0				
27. Other Agency Amount			\$0		\$0				
28. Other Agency In-Kind Amount					\$0				
29. Total Project Cost			\$12,431,961		\$12,431,961				
30. Fiscal Information									
Treas. Symbol	DCN	FY	Appropriation	Budget Org	PRC	Object Class	Site/Project	Cost Org	Ob/De-Ob Amt
682/30108	1205HHX002	1213	B	05HO0	202BJ7XF1	2506			1,859,745
682/30108	1205HHX002	1213	B	05HO1	202BJ7XF1	2506			435,022
682/30108	1205HHX002	1213	B	05HO0	202BJ7XF2	2506			253,130

Fiscal (Continued)									
Treas. Symbol	DCN	FY	Appropriation	Budget Org	PRC	Object Class	Site/Project	Cost Org	Ob/De-Ob Amt
682/30108	1205HHX002	1213	B	05HO6	202BJ7XF2	2506	-	-	1,638,700
682/30108	1205HHX002	1213	B	05HO0	202BJ7XF3	2506	-	-	1,539,876
682/30108	1205HHX002	1213	B	05HO3	202BJ7XF3	2506	-	-	300,000
682/30108	1205HHX002	1213	B	05HO0	202BJ7XF4	2506	-	-	1,556,751
682/30108	1205HHX002	1213	B	05HO1	202BJ7XF4	2506	-	-	2,350,000
682/30108	1205HHX002	1213	B	05HO0	202BJ7XF5	2506	-	-	2,411,737
682/30108	1205HHX002	1213	B	05HO3	202BJ7XF5	2506	-	-	87,000
									12,431,961

EPA Form 1610-1 (Rev. 11-09). Previous editions are obsolete.

Part II - Approved Budget

EPA IAG Identification Number

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31. Budget Categories	Itemization of All Previous Actions	Itemization of This Action	In-Kind Itemization of This Action	Itemization of Total Project Cost to Date
(a) Personnel		\$4,505,784		\$4,505,784
(b) Fringe Benefits		\$1,317,498		\$1,317,498
(c) Travel		\$730,918		\$730,918
(d) Equipment		\$850,288		\$850,288
(e) Supplies				\$0
(f) Procurement / Assistance		\$4,275,143		\$4,275,143
(g) Construction				\$0
(h) Other		\$137,366		\$137,366
(i) Total Direct Charges	\$0	\$11,816,997	\$0	\$11,816,997
(j) Indirect Costs:	\$0	\$614,964		\$614,964
Charged - Amount Rate: 5% Base: \$11,816,997.00 Not Charged: Funds-Out: Not charged by Other Agency Estimate by other Agency Amount \$				
(k) Total (EPA Share 100.00 %) (Other Agency Share 0.00 %)	\$0	\$12,431,961	\$0	\$12,431,961

32. How was the IDC Base calculated? Conference Report language encourages EPA and its federal partners to limit overhead. Consequently, the USGS will be required to minimize its indirect costs. In no event shall indirect costs exceed 5% during the project period of this IA.

Indirect costs are intramural and extramural costs not directly attributable to the USGS's project effort. These costs may include management and administrative support costs, headquarters' allocation of facilities, personnel compensation support costs to regions and program offices, regional management and support costs and program office support costs.

The 5% indirect costs will be used to support USGS Headquarters support (2%) and administrative costs to support USGS GLRI projects within the USGS (3%).

33. Is equipment authorized to be furnished by EPA or leased, purchased, or rented with EPA funds? ☒ Yes ☐ No
(Identify all equipment costing \$1,000 or more)

34. Are any of these funds being used on extramural agreements? ☒ Yes ☐ No

Type of Extramural Agreement Cooperative Agreement ; Contract

Contractor/Recipient Name (if known)	Total Extramural Amount Under This Project	Percent Funded by EPA (if known)
Various	4275143 Total \$ 4,275,143.00	100

Part III - Funding Methods and Billing Instructions

35. (Note: EPA Agency Location Code (ALC) - 68010727)

☒ Disbursement Agreement Request for repayment of actual costs must be itemized on SF 1080 and submitted to the Financial Management Office, Cincinnati, OH 45268-7002:

☒ Repayment ☒ Monthly ☐ Quarterly ☐ Upon Completion of Work

☐ Advance Only available for use by Federal agencies on working capital fund or with appropriate justification of need for this type of payment method. Unexpended funds at completion of work will be returned to EPA. Quarterly cost reports will be forwarded to the Financial Management Center, EPA, Cincinnati, OH 45268-7002.

☐ Allocation Transfer-Out Used to transfer obligational authority or transfer of function between Federal agencies. Must receive prior approval by the Office of Comptroller, Budget Division, Budget Formulation and Control Branch, EPA Hdqtrs. Forward appropriate reports to the Financial Reports and Analysis Branch, Financial Management Division, PM-226F, EPA, Washington, DC 20460.

36. ☐ Reimbursement Agreement ☐ Repayment ☐ Advance
☐ Allocation Transfer-In

Other Agency's Billing Address (include ALC or Station Symbol Number)

Other Agency's Billing Instructions and Frequency

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EPA Form 1610-1 (Rev. 11-09). Previous editions are obsolete

Part IV - Acceptance Conditions

EPA Identification Number

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37. Terms and Conditions, when included, are located at the end of the 1610-1, or as an attachment.

Part V - Offer and Acceptance

Note: A) For Fund-out actions, the agreement/amendment must be signed by the other agency official in duplicate and one original returned to the Grants and IA Management Division for Headquarters agreements or to the appropriate EPA Regional IA administration office within 3 calendar weeks after receipt or within any extension of time that may be granted by EPA. The agreement/amendment must be forwarded to the address cited in item 29 after acceptance signature.

Failure to return the properly executed document within the prescribed time may result in the withdrawal of offer by EPA. Any change to the agreement/amendment by the other agency after the document is signed by the EPA Award Official, which the Award Official determines to materially alter the agreement/amendment, shall void the agreement/amendment.

B) For Funds-In actions, the other agency will initiate the action and forward two original agreements/amendments to the appropriate EPA program office for signature. The agreements/amendments will then be forwarded to the appropriate EPA IA administration office for signature on behalf of the EPA. EPA will return one original copy after acceptance returned to the other agency after acceptance.

EPA IA Administration Office (for administrative assistance)

EPA Program Office (for technical assistance)

38. Organization/Address

39. Organization/Address

U.S. Environmental Protection Agency
IASSC West
1200 Sixth Avenue, Suite 900, OMP-145
Seattle, WA 98101

US Environmental Protection Agency
R5 - Region 5
77 West Jackson Blvd.
Chicago, IL 60604-3507

Award Official on Behalf of the Environment Protection Agency

40. Digital signature applied by EPA Award Official | Armina K. Nolan - Manager - Grants and Interagency Agreements Unit

Date

06/06/2012

Authorizing Official on Behalf of the Other Agency

41. Signature

Typed Name and Title

Date

Leon Carl, Director, Great Lakes Science Center

06/06/2012

IA Terms and Conditions

1. Participation in Great Lakes Water Quality Agreement (GLWQA) and Great Lakes Restoration Initiative (GLRI) Programs and Processes

The U.S. Geological Survey (USGS) shall participate in the Great Lakes Restoration Initiative (GLRI) and the Great Lakes Water Quality Agreement (GLWQA) programs, processes and activities including the Lakewide Management Plans and Programs (LaMPs), activities relating to Areas of Concern (AOCs), State of the Lake Ecosystem Conference (SOLEC), Cooperative Science and Monitoring Initiative (CSMI), and the Binational Toxics Strategy (BTS), as requested. Such activities shall include, but not be limited to, meetings, conferences, and workshops directly tied to carrying out and implementing the GLRI and GLWQA.

2. Participation in Planning and Budgeting Activities

The USGS will collaborate with EPA and other members of the Interagency Task Force regarding planning and budgeting activities for the Great Lakes Restoration Initiative including participation in Interagency Task Force meetings (as needed) and Regional Working Group meetings (as needed), assistance with budget development, development and updating of information for Congress and the public. This collaboration will include regular updates of an Interagency Funding Guide that will describe funding opportunities under the Initiative.

Information (including documents and conversations) regarding out-year budget development will be shared only among federal agency staff who must be involved in the out-year budget development process.

The USGS will collaborate with EPA to comply with requirements, including provisions for science review or competition, for the Great Lakes Restoration Initiative as expressed in conference and/or committee reports, and as required by statute.

Within a reasonable time after appropriations are made and revisions to allocations, the USGS shall update its template (identified in the attached Scope of Work) program descriptions for posting on the GLRI website.

3. Statutory Authority

The Statutory Authority of this IA is P.L. 112-74, the Department of Defense Appropriations Act, 2012.

4. The Agency's Effort on Great Lakes Activities

EPA will work with the USGS to ensure that the funds transferred under this IA are not used to supplant the base programs' funding of the USGS. EPA recognizes its effort in this regard must be consistent with USGS's statutory authorities.

5. Minimization of Indirect Costs

Conference Report language encourages EPA and its federal partners to limit overhead. Consequently, the USGS will be required to minimize its indirect costs. In no event shall indirect costs exceed 5% during the project period of this IA.

Indirect costs are intramural and extramural costs not directly attributable to the USGS's project effort. These costs may include management and administrative support costs, headquarters' allocation of facilities, personnel compensation support costs to regions and program offices, regional management and support costs and program office support costs.

The 5% indirect costs will be used to support USGS Headquarters support (2%) and administrative costs to support USGS GLRI projects within the USGS (3%).

6. Use of Contracts and Grants

A. USGS may use the funds transferred under this IA consistent with its grants, contracts and other

programs in order to support the GLRI and the GLWQA.

To the extent that the USGS uses funds transferred by EPA under authorities that have match requirements, the Agency shall minimize the required match to the extent allowed under its authorities and regulations, unless the EPA Project Officer agrees otherwise.

The USGS will use a competitive process to select awardees of grants and contracts consistent with its authorities and regulations. To the extent feasible, any Requests for Proposals (RFPs) for contract awards and grant awards, as well as invitation for bids, shall be shared with the EPA Project Officer and made available to other members of the Regional Working Group in a timely manner in advance of publication, allowing at least fifteen days for review and comment. The USGS will publish the name of those proposals which are selected and funded.

To the extent possible, contractors and awardees must commence work within 60 days of the effective date of an award.

B. The USGS will use the following principles for project selection as set forth in the templates and as reflected in the solicitations for the Agency's contracts and grants activities:

- Target projects to maximize environmental protection and restoration for the Great Lakes;
- Ability to advance implementation of GLRI Action Plan priorities;
- Ability to strategically-achieve measurable environmental outcomes linked to the highest priority issues;
- Ability to advance environmental priorities of existing Great Lakes strategic plans, especially the Lakewide Management Plans and Programs, Remedial Action Plans for Areas of Concern, the Binational Toxics Strategy and other relevant national and regional coordinated strategic planning efforts;
- Feasibility of prompt implementation, including a bias for action-ready projects and for those which demonstrate quick results;
- Observable local improvements, especially for projects at the field level;
- Bias for interagency/inter-organizational coordination and collaboration;
- Support for new work and for enhancements which do not replace existing Great Lakes base activities;
- Support by the Public and other Stakeholders;
- Ability to leverage non-federal resources;
- Promotion of long-term societal, economic, and environmental sustainability goals; and,
- Minimization of transaction costs.

C. Projects and activities must also meet standards for:

- Using best available science;
- Experience, ability, and authority of the funding recipient to properly perform the work;
- Reasonableness of project costs; and
- Measuring progress and success.

The USGS shall offer USEPA and the other Agencies represented on the Regional Working Group a timely opportunity to review RFP submissions and serve on RFP review and selection panels consistent with existing authorities and the USGS's policies.

7. Expedite Required Permits

The USGS shall obtain all required permits in a timely fashion for projects implemented under this IA. To the extent resources are required to expedite permit processing, EPA may authorize the use of IA resources for this purpose.

8. Fund Obligation/Utilization and De-obligation

All funding that the USGS utilizes pursuant to this Interagency Agreement shall be obligated by the USGS as expeditiously as possible for the foregoing programs, projects, and activities which support the Great Lakes Restoration Initiative and GLWQA. The Agency shall use its best efforts to obligate the funds

transferred by EPA before one year from the date of award of the agreement in order to minimize amounts that are returned to the EPA. Beginning in May 2012, the Agency shall report monthly to the Project Officer regarding its plans to use any funds which remain unobligated. Any funds which have not been obligated by one year from the date of award of the agreement shall be returned to EPA unless the EPA Project Officer has agreed in writing to (i) an extension or (ii) the funds' application to projects proposed by the Agency for the subsequent year's allocation or (iii) another mutually agreed-upon use pursuant to the Initiative. Notwithstanding any efforts by Agency to obligate such funds by one year from the date of award of the agreement, funds which remain unobligated after June 1, 2013 shall be de-obligated by EPA upon 10 days written notice to the USGS.

9. Health, Safety and Environmental Compliance

All health, lab and field activities conducted for this project must be in accordance and compliance with all applicable health, safety and environmental laws, regulations and guidelines.

10. Signage

The USGS shall ensure that a visible project identification sign is erected as appropriate at each on-the-ground protection or restoration project. Each sign must give project information and credit the Great Lakes Restoration Initiative and appropriate federal agencies for funding. The USGS will determine the design, placement, and materials for each sign.

11. Modification of Interagency Agreement and Written Approval for Transfers Among Templates

This Interagency Agreement can be amended or modified in writing upon consent of the Parties. The Scope of Work attached to this Interagency Agreement can be amended in writing upon consent of the Parties.

The Agency must receive prior written approval by the EPA Project Officer for cumulative transfers among templates or projects which exceed or are expected to exceed the lesser of \$100,000 or ten percent of the Recipient's approved allocation.

12. Reporting

The model for the Guidance is the Chesapeake Bay Guidance and its 11 attachments, which are available from: <http://www.epa.gov/region3/chesapeake/grants.htm#2009>.

Quarterly Progress Reports: USGS shall ensure that quarterly reporting is provided on funding utilized under GLRI and GLWQA activities. This reporting includes programs funded at or below \$500,000 that may not otherwise be identified in cross-cut budgets.

Semi-Annual Progress Reports: The Agency shall submit progress reports, beginning with the date of IA execution, every six (6) months during the life of this agreement. Reports shall be submitted to the EPA Project Officer and may be provided electronically. The reports must contain information in order to ascertain that the Scope of Work (SOW) is being carried out as specified in the Interagency Agreement. The EPA Project Officer must be able to determine that all mission support products, services, information or data generation and use, including technology development and verification, is performed in accordance with EPA policies and the IA agreement. The Agency and possibly its grantees and contractors, upon the direction of the Agency, may be able to input information directly into the system using specified formats and timeframes. The Agency shall ensure that by April 15 and October 15 of each year, information is reported in an accountability system, to be determined, pertaining to its contributions (including those from contracts and grants) to Goals, Objectives, and Measures under the GLRI Action Plan.

Annual Report: Beginning in FY 2012, EPA will work with its Interagency Task Force partners to prepare and submit an Annual Report to the President on progress in achieving the Initiative's goals, outcomes, and targets. To that end, the Recipient shall include in an annual report to EPA, information on its Great Lakes activities, including those funded pursuant to the Great Lakes Restoration Initiative and those funded by its base programs. The report shall include funding beginning in FY 2012 and each fiscal year thereafter, detail yearly program accomplishments, and compare specific funding levels allocated for

participating Federal agencies from fiscal year to fiscal year. Reporting shall include programs funded at or below \$500,000 that may not otherwise be identified in cross-cut budgets.

Final Progress Report: The USGS shall submit a final report to the EPA Project Officer upon expiration of this IA. This report shall incorporate project outputs and summarize the nature and extent of the project, methodologies employed, significant events and experiences, and a compilation of the data collected. The final report shall also include analysis of the data as well as conclusions, and recommendations. The final report shall incorporate photo documentation of funded projects and environmental progress under the projects at appropriate phases, and appropriate illustrations, diagrams, charts, graphs, and maps to express the data and findings. The draft Final Report will be submitted electronically to the USEPA Project Officer no later than 45 days after the end of the project period for review and comment. Electronic and paper versions of the Final Report shall be submitted no later than 90 days after the end of the project period.

13. Accountability/Performance System

EPA and the Regional Working Group will develop an electronic accountability and performance system that will be used in the reporting process for the GLRI. The system will include program and project information including project location, environmental progress and results and additional project statistics and such other matters as are agreed to by EPA and the Recipient. Great Lakes partners will be required to report information into the system that describes GLRI activities and demonstrates how results are being achieved pursuant to the Action Plan. Since we intend to collect data from ten or more non-federal partners, an Information Collection Request (ICR) describing the information we intend to collect and estimating the time and cost to answer the request must be approved by OMB before the collection begins.

Recipients and sub-recipients shall be responsible for inputting their accounting/performance data into the GLRI database. The website for the database will be accessible through the GLNPO website at www.epa.gov/glnpo.

14. Quality Assurance

The recipient must have a Quality Assurance (QA) and Quality Control (QC) System in place that will provide the needed management and technical practices to assure that environmental data used to support GLRI decisions are of adequate quality and usability for their intended purpose. This System must be in place before any data collection takes place. Since most of the GLRI decisions will rest on environmental data, a management system is needed that provides for:

1. Identification of environmental programs for which QA and QC activities are needed;
2. Specification of the quality of the data required from environmental programs; and,
3. Provision of sufficient resources to assure that adequate levels of QA and QC activities are performed.

This IA will provide mission support products, services, information or data generation including technology development and verification. Any of these activities will be performed in accordance with approved Quality Assurance procedures or standards with adequate documentation for transparency purposes, including review and approval by recipients QA manager. Because of the nature of the action, data may be collected without EPA review and approval of a project-specific Quality Assurance documents. The EPA Quality Assurance Officer must be notified when procedures are developed and the quality assurance procedures should be documented. Quality Assurance documentation should be maintained by the IA recipient, but must be provided for review by the EPA Quality Assurance Office on an as needed basis. This documentation should include, but is not limited to, (1) quality assurance procedures, including the rationale for decisions concerning sampling and analysis; (2) decisions on usability of data; and (3) information on quality-control methods and measurements, e.g., performance evaluation samples, field duplicates, field blanks, laboratory blanks, laboratory duplicates, laboratory surrogate and matrix spikes, laboratory control samples, and calibration. EPA Guidance for Quality Assurance Project Plans (QA/G-5) (EPA2002) can be found at: <http://www.epa.gov/quality/qmps.html>.

The USGS quality management system is documented in Appendix F.

15. Climate Change Emissions Minimization/Reductions

The USGS shall encourage (i) minimization and reduction, where possible, of greenhouse gas emissions resulting from activities carried out pursuant to this agreement and (ii) the tracking of the reduction of greenhouse gas emissions through these activities.

16. Contract Termination, Disputes and Protests

If a contract or order awarded pursuant to this IA is terminated or cancelled or a dispute or protest arises from specifications, solicitation, award, performance or termination of a contract, the USGS will take appropriate action in accordance with the terms of the contract and applicable laws and regulations. The EPA shall be responsible for all costs associated with termination, disputes, and protests, including settlement costs, except that the EPA shall not be responsible to the USGS for costs associated with actions that stem from errors in performing the responsibilities assigned to the USGS. The USGS shall consult with the EPA before agreeing to a settlement or payments to ensure that the USGS has adequate time in which to raise or address any fiscal or budgetary concerns arising from the proposed payment or settlement.

17. Termination

This IA may be terminated upon thirty (30) calendar days written notice by either party. If this agreement is cancelled, any implementing contract/order may also be cancelled. If the IA is terminated, the agencies shall specify the terms of the termination, including costs attributable to each party and the disposition of awarded and pending actions.

18. Interpretation of IA

If the USGS and EPA are unable to agree on the interpretation of a material aspect of this IA, the parties agree to engage in an effort to reach mutual agreement regarding the proper interpretation of this IA, including amendment of this IA, as necessary, by escalating the dispute within their respective organizations.

If a dispute related to funding remains unresolved for more than sixty (60) calendar days after the parties have engaged in an escalation of the dispute, the parties agree to refer the matter to their respective Agency Chief Financial Officers with a recommendation that the parties submit the dispute to the CFO Council Intragovernmental Dispute Resolution Committee for review in accordance with Section VII of Attachment 1 to the Treasury Financial Manual, Volume 1, Bulletin No. 2007-03, Intragovernmental Transactions, Subject: Intragovernmental Business Rules, or subsequent guidance.

19. Indirect Costs

The USGS certifies that (1) any indirect costs incurred by the U.S. Geological Survey included in billings to EPA represent, in accordance with generally accepted accounting principles, indirect costs that would not have been otherwise incurred by the performing agency, or (2) statutory authority exists for charging other than the incremental costs of performance. If an audit determines that any direct or indirect costs charged to EPA are unallowable, EPA will be notified immediately following the resolution of the audit and EPA will be credited those amounts.

20. Billing Payments

When submitting invoices to the Office of the Chief Financial Officer/Cincinnati Finance Center (OCFO/CFC) requesting payment, a breakdown of the costs associated with the invoice must be provided to the EPA Project Officer (EPA PO). This information allows the EPA PO to determine that costs billed to EPA are necessary and reasonable. If this information is not provided, the EPA PO will notify the OCFO/CFC to suspend or charge back the payment.

21. Payment.

Not more than 30 days before incurring reasonable and necessary costs described in the scope of work, USGS may, pursuant to this Agreement, submit an estimated payment request via the IPAC system for the electronic transfer of funds to pay such costs. When an IPAC charge is reflected against the CFC's Agency Location Code (ALC) 68-01-0727, the Treasury Department will automatically transfer funds to the

requesting Agencies ALC. USGS will use its best efforts to obligate/ expend any funds it receives within 30 days of receipt. On a monthly basis, a breakdown of the costs associated with payments must be provided to the EPA Project Officer (EPA PO). This information allows the EPA PO to determine that costs billed to EPA are necessary and reasonable. If this information is not provided, the EPA PO will notify the OCFO/CFC to suspend or charge back the payment. For further information, please contact:

U.S. EPA CFC
Attn: Jeff Marsala
26 W. ML King Dr.
Cincinnati, OH 45268-7002

E-mail: Marsala.Jeffrey@epa.gov

22. IAs with Contracts or Procurement

In accordance with Public Law (P.L) 102-389, EPA's policy requires, to the fullest extent possible, that at least 8% of its overall Federal funding for prime and subcontractors awarded in support of authorized programs be awarded to business concerns or other organizations owned or controlled by socially and economically disadvantaged individuals, including historically black colleges and universities and women. Also, in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended (P.L. 99-499), Section 105, any Federal agency awarding contracts, grants or cooperative agreements utilizing Superfund monies shall consider the availability of minority contractors for participation in contracts. This includes, but is not limited to: contracts, subcontracts and any sub-agreements.

The IA recipient agrees, in awarding contracts under this IA, to comply with EPA's aforementioned utilization policy for Minority Business Enterprises (MBEs) and Women's Business Enterprises (WBEs), which is codified at 40 C.F.R. Part 33. Where the subject IA is for the benefit of Native Americans, the IA recipient agrees to comply with the provisions found at 40 C.F.R. Section 33.304(c), which provides for the preference for Indian-owned economic enterprises and Indian organizations in contracting. The IA recipient will also strive to meet EPA's SBA negotiated goals for awarding contracts to small and disadvantaged businesses. The IA recipient will accomplish these objectives through adherence to the small and minority-owned business requirements set forth in the Small Business Act, 15 U.S.C. §§ 631 et seq., and the annual Small Business goals negotiated with the IA recipient and Small Business Administration. All reporting on MBE/WBE and small business accomplishments will be accomplished through the existing federal contracting reporting mechanism, currently the Federal Procurement Data System, Next Generation.

The report should be submitted to:

Office of Small Business Programs
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW (Mall code: 1230T)
Washington, D.C. 20460

A copy should be sent to:

Greg Luchey, DBE Coordinator
U.S. EPA Region 10
1200 Sixth Avenue, Suite 900
Mail Stop: OMP-145
Seattle, WA 98101

23. Equipment Disposition - Title to Other Agency

Property/equipment authorized under this IA will be titled with the USGS and subject to the USGS's property management procedures with no further accountability to EPA.

24. International travel is not allowed by USGS under this IA until USEPA receives the OIA clearance forms.

25. Sufficient Progress

EPA expressly reserves the right to terminate this IA for failure to make sufficient progress so as to reasonably ensure completion of the project within the project period, including any extensions. EPA will measure sufficient progress by examining the performance required under the Statement of Work, the time remaining for performance, and/or the availability of funds necessary to complete performance. In exercising the right to terminate, EPA will follow the procedures for terminating the IA in the Terms and Conditions.

26. Restrictions on FY12 Funding for Corporations with Unpaid Federal Tax Liabilities and Felony Convictions

This IA obligates and transfers or advances EPA funds appropriated under the Department of Interior, Environment, and Related Agencies Appropriations Act, (FY12 Appropriations Act). As a result, this interagency agreement (IA) is subject to the provisions of Division E, Sections 433 and 434 of the Appropriations Act, regarding federal felony convictions and unpaid federal tax liabilities. Specifically,

Section 433 provides:

None of the funds made available by this Act [FY12 Appropriations Act] may be used to enter into a contract, memorandum of understanding, or cooperative agreement with, make a grant to, or provide a loan or loan guarantee to, any corporation that was convicted (or had an officer or agent of such corporation acting on behalf of the corporation convicted) of a felony criminal violation under any Federal law within the preceding 24 months, where the awarding agency is aware of the conviction, unless the agency has considered suspension or debarment of the corporation, or such officer or agent, and made a determination that this further action is not necessary to protect the interests of the Government.

Section 434 of Division E of the Appropriations Act further provides:

None of the funds made available by this Act [FY12 Appropriations Act] may be used to enter into a contract, memorandum of understanding, or cooperative agreement with, make a grant to, or provide a loan or loan guarantee to, any corporation with respect to which any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability, where the awarding agency is aware of the unpaid tax liability, unless the agency has considered suspension or debarment of the corporation and made a determination that this further action is not necessary to protect the interests of the Government.

Accordingly, by accepting the award of this IA, the Recipient agrees that it will comply with and implement the prohibitions of Sections 433 and 434 for any contract, assistance agreement, loan, loan guarantee or other instrument with any corporation that will be funded with funds provided under this IA.

Non-compliance with the provisions of Sections 433 and 434 may implicate the Antideficiency Act. The Recipient will forward to the EPA Award Official, within 45 days, any determination and documentation supporting an award where suspension and debarment are considered by the awarding agency.

27. Expiration of Funds under Non-Economy Act

For IAs with fixed year funding and executed under any authority other than the Economy Act, if funds are properly obligated on an IA, a performing agency may in turn obligate/expend these funds until the IA ends or the work is complete, whichever is first.

END OF INTERAGENCY AGREEMENT #DW-14-95822901-0

Great Lakes Restoration Initiative

Interagency Agreement

Scope of Work

AGENCY NAME: U.S. Geological Survey

CONTACT INFORMATION: Norman Grannemann (517-887-8936)

1. INTRODUCTION

Recognizing that the Great Lakes ecosystem is an invaluable resource containing over 20% of the world's surface freshwater and providing drinking water to over 40 million people, the Administration, in 2009, announced the Great Lakes Restoration Initiative (GLRI) to protect, restore and maintain the Great Lakes ecosystem. In conjunction with 15 other Federal Agencies, the USEPA will implement strategic, priority actions to achieve the vision of a restored, protected and sustainable Great Lakes ecosystem.

The purpose of this Interagency Agreement (IA) is to provide funding to the U.S. Geological Survey (USGS) to help implement the priorities of the GLRI. Specifically, this IA will implement priority programs, projects, and activities to protect, restore and maintain the Great Lakes ecosystem. This IA will also utilize USGS to implement priorities, programs and projects of the Great Lakes Water Quality Agreement such as the Lakewide Management Plans, the Remedial Action Plans for Areas of Concern, the Binational Toxics Strategy, and the Cooperative Science and Monitoring Initiatives, among others.

The GLRI Action Plan identifies goals, objectives, measurable ecological targets, and specific actions for five focus areas—Toxic Substances and Areas of Concern; Invasives Species; Nearshore Health and Nonpoint Source Pollution; Habitat and Wildlife Protection and Restoration; and Accountability, Education, Monitoring, Evaluation, Communication and Partnerships.

Milestones from Past GLRI Funding

- **Native Fish Restoration** -- Approximately 65,000 fall fingerling Atlantic salmon were released in Lake Ontario tributaries in September 2011. Another 8,000 fall fingerling salmon were released in St. Lawrence River tributaries in October in partnership with the St. Regis Mohawk Tribe.
- **Wetland Restoration** -- Through extensive partnerships with the U.S. Fish and Wildlife Service and Ducks Unlimited, a fish passage structure was constructed at Ottawa National Wildlife Refuge to restore hydrologic connection between a 100-acre coastal wetland and Lake Erie waters for the first time in nearly 40 years. Intense data collection by USGS and close interaction with refuge managers have led to an unprecedented look at the system response to a large wetland restoration action, implementation of adaptive management practices, and recognition of water quality improvements associated with habitat restoration in the Maumee River Area of Concern.
- **Phragmites Control** -- Extensive work by Dr. Rusty Rodriguez at the USGS -- Western

Fisheries Research Center has identified several fungal endophytes in *Phragmites*. This is significant because no one else had successfully isolated and identified endophytes in *Phragmites* previously. This discovery allows the project to continue its work to examine the symbiotic relationship between endophytes and its host invasive plant and seek ways to target this relationship as a form of control. The end result could be an innovative management tool that is unlike conventional chemical, mechanical, or biological methods of control.

- **USGS Support for LaMPs** -- Template 330 provided continued support of coordinating activities with LaMP partners. Emphasis was placed on extending work completed for the Lake Michigan data web-mapper to all of the Great Lakes with the goal of expanding on previous efforts, resulting in recognition of areas where data are missing or sparse or where ecosystems are vulnerable. Scientists worked closely with partners. In Lake Huron, emphasis focused on issues affecting fisheries and nutrient inputs. For Lake Superior, emphasis was placed on support of data activities in areas with potential for mining development. For Lake Michigan, efforts included compilation of historic data into the web-mapper as well as support of a near-shore white paper. Lake Ontario efforts focused around attending LaMP meetings and providing science expertise for collecting benthos data to provide information to help EPA Region 2 make decisions on delisting the St. Lawrence-Massena AOC. For Lakes Erie and Huron emphasis was placed on coordinating activities with partners. Activities of the Great Lakes Science Center included coordinating activities with partners in each of the Great Lakes and on support for near-shore sampling and monitoring activities.
- **Huron-Erie Corridor Fish Restoration** -- Funding provided by Template 70 resulted in development of innovative sampling techniques to assess fish spawning and nursery habitat use in deep riverine systems in the St. Clair and Detroit rivers which documented spawning by several native fishes on remnant natural and recently constructed habitats to include rare, threatened, and endangered fishes as well as locally and regionally important sport and commercial fishes.
- **Avian Botulism** -- Funding for Template 73 resulted in development of an *in vitro* assay to detect type-E botulism toxin (BoNT/E). This assay has equivalent sensitivity and specificity to the "gold-standard" mouse bioassay, and is a major step forward in the study of botulism. The assay is now being tested on environmental samples (e.g., sediment). A citizen science program was established: Lake Michigan Volunteer AMBLE (Avian Monitoring for Botulism Lakeshore Events). We now have increased knowledge of timing, numbers, and species affected by avian botulism by increasing shoreline.
- **Lake Michigan Fishery Expertise for Native Fishery Restoration** -- Funding for Template 74 resulted in completion of a Lake Michigan Ecosystem Model that is being used by fishery managers to explore different stocking scenarios to support restoration of native lake trout.
- **Data for Phosphorus and Toxic Contaminant Loading to the Great Lakes** -- Thirty monitoring sites have been outfitted with automated samplers and real-time water-quality sondes. Data collected at these sites include nutrients, chloride and other major ions, and suspended sediment. Sondes measure dissolved oxygen, turbidity, specific conductance, pH, and temperature. Data from sondes will be used to develop regression relationships with water-quality variables to provide cost-effective monitoring in the future.
- **Beach Health** -- Currently 51 beaches (3 IL, 6 IN, 6 MI, 5 NY, 11 OH, 10 PA, 10 WI) are in the process of developing real-time models that will allow beach managers to improve decision-making. Many of these models will be available for active use during the 2013

beach season with the remainder available in the 2014 season.

- **Pathogen Analysis for Beaches and Watersheds** -- Over 400 samples were obtained from 12 Great-lakes beaches and in summer of 2010, for genes indicating pathogenic bacteria in the genera *E. coli*, *Enterococcus*, *Salmonella*, *Shigella*, *Campylobacter* and *Staphylococcus*. These samples will enable a comparison between the indicators currently being used and actual human pathogen occurrence.
- **Methyl-Mercury Sampling and Analysis in Great Lakes Water Column** -- Completion of three basin-wide sampling efforts (August 2010, April 2011, and August 2011) of the water column, bottom sediments, benthic fauna, and zooplankton across the entire Great Lakes Basin (about 80 sampling locations in total for each cruise). Data from these efforts have revealed a previously unknown source of methyl-Mercury (mid-water column methylation) that likely is the dominant source leading to elevated concentrations throughout the Great Lakes.
- **Indicator Bird Species Contaminant Information for BUI Removal at AOCs** -- Baseline contaminant information was collected from across the Great Lakes in tree swallows as well as other colonial waterbirds. In addition to the 22 Great Lakes locations evaluated in 2010, 10 new sampling sites were added in 2011. These sites now include 14 AOCs of which 4 were new in 2011. Sampling sites include locations on all 5 Great Lakes and various connecting waterways and major tributaries. This is the most comprehensive data set available; it allows for comparisons across all sites sampled on the same species, something that has been lacking to date.

Focus Areas and FY 2012 Allocations

With FY 2012 allocations, and with the funds transferred under this IA, USGS will undertake actions in the focus areas below. The work being performed by USGS has timelines that are not severable because of the on-going nature of the work in each focus area. Most of the work that is described in the templates below relate to GLRI activities that were previously funded by a previous Interagency Agreement that was initiated in 2010. The activities that USGS will undertake are set forth in this Scope of Work.

USGS Authority for Work

USGS authority to complete work under this project is pursuant to Public Law 99-591 that bestows permanent authority on the USGS to “prosecute projects in cooperation with other agencies, Federal, State, and private” (43 U.S.C. 36c), the USGS Organic Act of March 3, 1879, as amended (43 U.S.C. 31 *et seq.*), and the Water Resources Research Act of 1984 (42 USC 10303 (h)(1)(D))

USGS requests that the budget period for the FY2012 agreement be set to extend into FY2016. This period of performance allows for the completion of and expenditures on templates in the agreement some of which are non-severable.

2. BUDGET & PROJECT DETAIL

Focus Area	Project Title (template no.) Page no.	Draft Allocation
TX	Determine Baseline and Sources of Toxic Contaminant Loadings (078) Page 6	\$548,449
TX	Mercury Cycling and Bioaccumulation in the Great Lakes (079) Page 7	\$147,659
TX	Birds as Indicators of Contaminant Exposure in the Great Lakes (080) Page 9	\$464,072
TX	Riparian Indicators of Contaminant Exposure in AOCs (146a) Page 11	\$70,000
TX	Rochester Benthos Evaluation (146b) Page 12	\$70,000
TX	St. Lawrence Benthos Evaluation (146c) Page 15	\$45,022
TX	Determining Sources of Bacterial Contamination at Jeorse Park Beach, IN Lake Calumet AOC (146d) Page 17	\$80,000
TX	Development of Critical Information (147) Page 19	\$493,000
TX	Riparian Indicators of Contaminant Exposures in AOCs (370) Page 21	\$250,000
TX	AOC Decision Support for BUI Removal (384) Page 23	\$126,565
TX	Total	\$2,294,767

IS	Innovative Phragmites Control Strategies (067) Page 26	\$253,130
IS	Asian Carp Control (673) Page 28	\$1,638,700
IS	Total	\$1,891,830

NS	Avian Botulism in Distressed Great Lakes Environments (073) Page 42	\$569,543
NS	Forecast/Nowcast Great Lakes Nutrient and Sediment Loadings (076) Page 44	\$506,261
NS	Enhance Great Lakes Beach Recreational Water Quality Decision Making (077) Page 45	\$464,072
NS	Fox River Edge-of-Field Monitoring (366) Page 47	\$100,000
NS	Maumee River Edge-of-Field Monitoring (367) Page 48	\$100,000
NS	Saginaw River Edge-of-Field Monitoring (368) Page 50	\$100,000
NS	Total	\$1,839,876
H	Habitat Enhancement Strategies for the Detroit River (070) Page 52	\$675,014
H	New Strategies for Restoring Coastal Wetland Function (071) Page 55	\$295,319
H	Native Fish Restoration (072) Page 59	\$322,319

H	Changes in Nutrient Transfer within Great Lakes Food Webs: Implications for Fish Production (074) Page 61	\$264,099
H	St. Clair River Area of Concern, Fish Habitat Restoration (379) Page 63	\$2,350,000
H	Total	\$3,906,751

AEMECP	Watershed Modeling for Stream Ecosystem Management (081) Page 68	\$421,884
AEMECP	Characterizing Habitat and Food Web Structures Across Great Lakes Estuaries (082) Page 69	\$210,942
AEMECP	Compilation of USGS Data for the Great Lakes Basin (084) Page 73	\$337,510
AEMECP	Lake Ontario CSMI Lower Trophic Level Data (183a) Page 74	\$87,000
AEMECP	Understanding Nutrient Loading Impacts on Lake Ontario Nearshore Waters (183b) Page 77	\$363,910
AEMECP	Lakewide Management Plan Capacity Support by U.S. Geological Survey (330) Page 80	\$318,100
AEMECP	Implementation of the Great Lakes Observing System (332) Page 83	\$506,261
AEMECP	Forecasting Great Lakes Basin Response to Future Change (588a) Page 85	\$142,505
AEMECP	Forecasting Potential Phragmites Coastal Invasion Corridors (588b) Page 86	\$110,625
AEMECP	Total	\$2,498,737
	Grand Total	\$12,431,961

3. NARRATIVE SCOPES OF WORK

Toxic Substances and Areas of Concern

Template 78 - Determine Baseline and Sources of Toxic Contaminant Loadings

Total funding: \$548,449

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The USGS contaminant and virus tributary monitoring network follows the National Monitoring Network for Coastal Waters design. The monitoring effort includes collecting emerging contaminant samples at 17 sites, a subset of the 30 nutrient monitoring sites (Template 76); and for human viruses and other waterborne pathogen samples at 8 of these 17 sites; using automated, passive, surrogate, and manual sampling. This information will provide baseline information, provide support for measuring restoration progress, and provide potential load change information throughout the Great Lakes.

Because of the ongoing nature of this work, it is non-severable.

Milestones

At a subset of the 30 tributary monitoring sites, data on contaminants, viruses, and pathogens have been collected beginning in the fall of 2010. In Year 3 of the GLRI, samples will continue to be collected monthly and during events at 17 sites for chemicals of emerging concern (PPCP - pharmaceuticals and personal care products) and for human viruses and other waterborne pathogens. These sites are a mix of land use including agricultural, urban and reference conditions. Ten of the sites are at AOCs. Frequency of sample collection will be reviewed in spring 2012 to determine if sampling can be reduced at some sites. If frequency is reduced, funding will be realigned to sample measurable indicators to support tier 1 and tier 2 BUI removal efforts.

Measures of Progress

1.2 Area of Concern Beneficial Use Impairments removed.

Monitoring of contaminants of emerging concern (PPCP - pharmaceuticals and personal care products) will help determine if programs to collect unwanted medicines are successful in decreasing the amount of these chemicals reaching the Great Lakes and to provide baseline information for tracking potential future toxic contaminant threats. The virus sampling will provide a baseline for human and bovine viruses in tributaries and their potential impacts on human health. The monitoring will help determine if goals 2, 3, and 4 in Focus Area 1 are met. Goal 2: The release of toxic substances in toxic amounts is prevented and the release of any or all persistent toxic substances (PTS) to the Great Lakes basin ecosystem is virtually eliminated.

Goal 3: Exposure to toxic substances from historically contaminated sources is significantly reduced through source reduction and other exposure reduction methods.

Goal 4: Environmental levels of toxic chemicals are reduced to the point that all restrictions on the consumption of Great Lakes fish can be lifted.

Collaborative Arrangements

Streamgages at all sites are supported by a variety of cooperative agreements. This effort will be coordinated with activities being conducted by the EPA, COE, FWS, States and other monitoring entities.

Budget Information

Personnel	\$ 153,883
Fringe Benefits	\$ 51,294
Travel	\$ 10,000
Equipment/Supplies	\$ 5,000
Contracts	\$ 0
Cooperative Agreements	\$ 0
Indirect Costs	\$ 27,422
Laboratory	\$ 300,850 (USGS-NWQL and USGS/ARS virus lab)
Total	\$ 548,449

Template 79 - Mercury Cycling and Bioaccumulation in the Great Lakes

Total funding: \$147,659

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The USGS will develop information on the internal (within lake) and external (watershed) sources of methylmercury, which is the form of mercury that bioaccumulates in fish and other aquatic organisms, for all five Great Lakes. In the absence of this information, prescribing corrective measures for unsafe mercury levels in sport and commercial fish are very difficult to ascertain.

In FY 2012, the focus of work funded by this template will be to refine and more accurately estimate the internal production and watershed loading of mercury and methylmercury for each Great Lake; and to collaborate on the production of a numerical simulation model of mercury cycling (driven by sources and key processes) with a focus on Lake Michigan and Lake Superior.

Milestones

Analysis of samples collected from tributary streams discharging to the Great Lakes. These data will be merged with GIS information on watershed land-use information to yield a model of

mercury and methylmercury loads by watershed type which will be compared to mercury data from the Lakes' water column.

Measures of Progress

1.2 Area of Concern Beneficial Use Impairments removed.

Decisions about removal of mercury related fish consumption BUIs and delisting of AOCs will be supported by the information provided by work funded by this template. Goal 4 of Focus Area 1 – Environmental levels of toxic chemicals are reduced to the point that all restrictions on the consumption of Great Lakes fish can be lifted.

Collaborative Arrangements

Lake water column samples have been obtained in collaboration with USEPA on their vessel the Lake Guardian. Samples for mercury will be obtained in collaboration with work funded by templates 76, 78, and 81.

One of the Great Lakes watershed landscapes that may be contributing a major component of the MeHg that is accumulating in food webs is shoreline wetlands. GLRI project #71 (PI Kurt Kowalski) is focused on restoring natural hydrologic processes in diked coastal wetlands adjacent to Great Lakes waters to improve fish and wildlife habitat. While wetland restoration is a major aspect of several large ecosystem restoration programs nationally (Everglades, San Francisco Bay, and Great Lakes), from the perspective of minimizing mercury contamination of local food webs, these two goals can be at odds. Therefore, we will to conduct collaborative studies with Dr. Kowalski to determine whether the goals of the coastal wetland restoration project might lead to enhance MeHg bioaccumulation in fish that inhabit those wetlands, or if increased communication (water exchange) might lead to increased MeHg loading to the Great Lakes. The two project leaders will seek to coordinate the field efforts such that estimates for MeHg fluxes are derived, and to document whether enhanced MeHg body burdens in fish result from the opening of currently diked wetlands. This project will seek to use novel field approaches to document Dissolved Organic Material, Hg and MeHg fluxes from shoreline wetlands. These measurements will not only be useful for this project, but they will also be used for wetland restoration goals and enhance our ability to predict future Great Lakes water quality should expansive wetland restoration in the basin proceed.

Budget Information

Personnel	\$ 97,707
Fringe Benefits	\$ 32,569
Travel	\$ 5,000
Equipment	\$ 5,000 (supplies)
Contracts	\$ 0
Cooperative Agreements	\$ 0
Indirect Costs	\$ 7,383
Total	\$ 147,659

Template 80 - Birds as Indicators of Contaminant Exposure in the Great Lakes.

Total funding: \$464,072

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Work supported under this project is quantifying exposure to, and effects of, both historical and emerging contaminants on Great Lakes food chains using sentinel indicator species such as colonial waterbirds and tree swallows. Results will contribute directly to assessments of Great Lakes ecosystem health and science-based decision making, provide data that will be directly used by States and EPA to assess whether specific BUIs can be removed and AOC's subsequently delisted, provide a baseline for future trend analysis, and determine the effectiveness of recent remediation actions at AOCs and other known hotspots.

The tree swallow data provide for a biological matrix that is consistent across all AOCs and allows direct comparisons among AOCs and comparisons to non-AOC locations across not only the Great Lakes, but also the northern tier of states in the U.S. as well as Canada. Because swallows can be enticed to nest at AOCs with the use of nest boxes, similar data will be available for all AOCs. Because there are effects thresholds already established for tree swallows, or other avian species, it can be determined directly whether exposures to contaminants of various chemical classes are at or above levels of concern. The collection of colonial waterbird data, where those species occur, in conjunction with the tree swallow data, will allow for modeling and assessment of possible contaminant effects throughout the aquatic ecosystem. The limited feeding radius of swallows and close ties to sediment contamination allow for an assessment of the biological availability of sediment contaminants as well as quantification of changes in sediment contamination that will be directly usable by EPA in remedy effectiveness assessments.

Milestones

Work to be completed during 2012 will build selectively on work completed during the previous two years. Extensive baseline contaminant information was collected during 2010 and 2011 from across the Great Lakes in tree swallows as well as other colonial waterbirds. In addition to the 22 Great Lakes locations evaluated in 2010, 10 new sampling sites were added in 2011 (Figure 1). These sites now include 14 AOCs of which 4 were new in 2011. Sampling at 3, and possibly 6, more AOCs will be instigated for 2012 including the Kalamazoo, Clinton, and St. Clair Rivers AOCs. Additionally, several new sites at AOCs previously sampled in 2010 and 2011 will be added in 2012 to more fully describe contamination patterns. These include Green Bay/Fox River and the Sheboygan River AOCs. Sampling sites include locations on all 5 Great Lakes and various connecting waterways and major tributaries. This is the most comprehensive avian data set available for the Great Lakes; it allows for comparisons across all sites sampled on the same species, something that has been lacking to date.

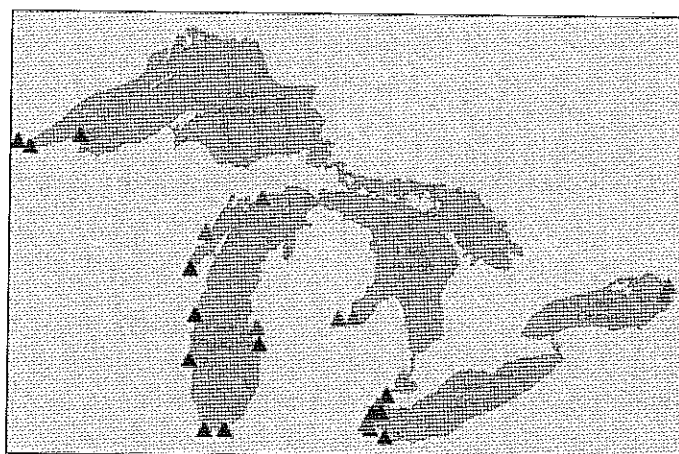


Figure 1. Sampling sites in 2010 (red triangles) and 2011 (green triangles)

Effects endpoint information was collected in 2010-2011 from across the Great Lakes in tree swallows at all 32 sites and will continue in 2012. At each active nest box at these sites, 14 independent measures of exposure and effects are being quantified. Exposure data include both legacy contaminants (PCBs, dioxins/furans, pesticides, mercury), as well as new and emerging contaminants (PBDEs, PFCs). Effects data range from genetic damage endpoints to population-level effects on reproduction, which are important metrics in assessing two wildlife BUIs. This extensive range of effects endpoints covers numerous possible effects of many different classes of chemicals at many different levels of biological organization.

A web site was established for GLRI Project 80 which provides access to preliminary results (http://www.umesc.usgs.gov/wildlife_toxicology/glri_project80.html). These results are being updated frequently as new information becomes available, and currently include summary data on mercury, lead, other trace elements, biomarker results, and several organic contaminant classes. These data are immediately accessible to managers and regulators in a useful format. Results from 2010 demonstrate patterns of contamination throughout the Great Lakes and puts each site into context with one another. Sites are ranked to determine relative degree of contamination and presented in mapped format for easy viewing and understanding. Data as presented can be used by State and Federal agencies to assess two wildlife BUIs.

Under a previous Interagency Agreement, Project 80 collected pre-remediation contaminant data at the following AOCs: Lincoln Park (Milwaukee Estuary), Hartshorn (Muskegon Lake), River Raisin, Ottawa River (Maumee River), Sheboygan River, Manistique, and Rouge River. Sampling at these AOCs following remediation will allow an assessment of the remediation effectiveness.

Measures of Progress

1.2 Area of Concern Beneficial Use Impairments removed.

Results will contribute directly to assessments of Great Lakes ecosystem health and science-based decision making, provide data that directly contribute to BUI removal and AOC delisting assessments, provide a baseline for future trend analysis, and determine the effectiveness of recent remediation actions at AOCs and other known hotspots. Specifically, all of the tree

swallow and colonial waterbird data can be used directly by States and EPA to determine whether two BUIs – (1) Bird or Animal Deformities or Reproductive Problems and (2) Degradation of Fish and Wildlife Populations – can be removed. These data are being provided to States and EPA in a format and style that enable their immediate and efficient use. The tree swallow data can also be used in the remedy effectiveness context, directly and immediately, at those locations when remedies have already been implemented. Concentrations in tree swallow tissues are being measured pre- and post-dredging to assess remedy effectiveness for biological endpoints.

Collaborative Arrangements

Partners include FWS, EPA, NPS, NOAA, Canadian Wildlife Service, Great Lakes States, cities, universities, and various RAP coordinators and committees. Specifically, the Sheboygan, Green Bay/Fox River, and Menominee RAP groups have been using the tree swallow data as they move forward with their Stage 2 RAPs. The Waukegon Harbor CAC and the St. Mary's River RAC have requested Project 80 to collect swallow data at their respective AOCs. Project 80 is also collecting remedy effectiveness data, in close collaboration with EPA personnel, at the Ottawa River, Muskegon Lake (Division St. Outfall), and Manistique.

Budget Information

Personnel	\$ 85,779
Fringe Benefits	\$ 24,194
Travel	\$ 10,000
Equipment	\$ 2,000
Contracts	\$ 320,000
Indirect Costs	\$ 22,099
Laboratory	\$ 0
Total	\$ 464,072

Template 146a - Riparian Indicators of Contaminant Exposure in AOCs

Total Funding: \$70,000

Statutory Authority: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

This project will support Template 370 by funding work at contract laboratories. Samples of spiders, adult aquatic insects, terrestrial insects, and other terrestrial arthropods from the Manistique River and Harbor AOC and the Ashtabula AOC will be collected and sent to contract laboratories for analysis. US EPA (GLNPO and ORD) and other Federal, State, and Local agencies may also collect additional data on contaminant concentrations in water, sediment, and biota at these sites.

Milestones

1. Study sites selected, contracts with analytical laboratories in place, field crews ready and trained, supplies purchased and available, field collection ready to begin; April, 2012.
2. Field collections completed, sample databases prepared, samples shipped to chemical laboratories; Summer, 2012

Measures of Progress

1.2 Area of Concern Beneficial Use Impairments removed.

Supports Goal 1: AOCs are cleaned up, restoring areas and removing BUIs and Goal 3: Exposure to toxic substances from historically contaminated sources is significantly reduced through source reduction and other exposure reduction methods.

Specific BUIs addressed by this research are:

1. Degradation of fish and wildlife populations
2. Degradation of benthos (riparian predators consume contaminated aquatic insects that originate in the benthos)
3. Restrictions on dredging (measurement of sediment PCB concentrations).

AOC managers can use data provided by these studies as:

1. Baseline monitoring to establish current BUI conditions and/or determine delisting criteria
2. Pre-remedial data to help with design of remedial action
3. Verification data to establish that BUI removal criteria have been met.

Collaborative Arrangements

USGS will work with State and RAP partners to develop the information needed to support BUI removal.

Budget Information

Personnel	\$ 0
Fringe Benefits	\$ 0
Travel	\$ 0
Equipment	\$ 0
Supplies	\$ 0
Contracts	\$ 66,500
Other	\$ 0
Indirect Costs	\$ 3,500
Total	\$ 70,000

Template 146b - Sediment Toxicity and Status of Benthic Invertebrate Communities in the Rochester Embayment Area of Concern — (Phase I)

Total funding: \$70,000

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The study will be implemented in two phases due to logistical constraints and the need to incorporate methods developed (and findings) from a comparable investigation underway in another AOC. The first phase will consist of site selection, methods refinement, work-plan development, subcontract assembly, site reconnaissance, and sediment collection which will be done mainly during FY2013. The second phase will consist of macroinvertebrate identification, sediment toxicity testing, data analysis and interpretation, and report preparation and review mainly during FY2014. In brief, we will generate bed sediment toxicity and benthic community data needed to test two related hypotheses that address the two criteria for delisting the benthos BUI. The **first hypothesis** is that bed sediments at selected sample locations in the AOC are no more toxic to the test species than bed sediments collected from reference (control) sites located outside the AOC. Acute (survival) and chronic (growth) whole bed-sediment toxicity tests will be conducted using the midge (*Chironomus dilutus*), following standard methods (USEPA 1994; USEPA 2000). The **second hypothesis** is that the benthic macroinvertebrate communities from targeted sites within the AOC are not significantly different, or are affected (impacted) no more seriously than the communities encountered at reference sites located outside the AOC according to spatial patterns in benthic community composition (nonparametric ordination) and the Biological Assessment Profile (BAP) index and component metrics for Ponar samples collected from soft bed sediments (fig. 1) developed by NY State Department of Environmental Conservation (Bode et al. 2002; Smith et al. 2009). The component metrics of the BAP include: SPP (species richness), HBI (Hilsenhoff Biotic Index), DOM3 (Dominance-3), PMA (Percent Model Affinity), and DIV (species diversity). The mean score of the five indices denotes the overall BAP and associated impact for each site.

Although several bed sediment-collection methods are suitable, the Petite Ponar sampler will be used to collect 5 replicate macroinvertebrate-community samples and a single composite sample for bed sediment toxicity tests at each study site. Bed-sediment sizes will be characterized by either the U.S. Geological Survey (USGS) Sediment Laboratory or NYSDEC subcontract laboratory using a subsample (split) obtained from the composite bed sediment-toxicity sample. Statistical analyses and multivariate (ordination) methods will be used to test the two hypotheses and to determine if the bed sediments within the St. Lawrence River at Massena AOC meet either criterion for delisting the benthos BUI.

Because of the ongoing nature of this work, it is non-severable.

Milestones

An adaptive management timeline, which shows the estimated periods (or window of time) when task components are scheduled to be conducted, is provided below.

Task	Fiscal Year 2012												Fiscal Year 2013												Fiscal Year 2014											
Description	o	n	d	j	f	m	a	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s
Assemb workplan																																				
Select study sites																																				
ID taxon & toxic labs																																				
Recon sites/methods																																				
Collect bug/sedi samples																																				
Conduct bioassays																																				
Process invert samples																																				
Verify and summ toxic & taxon data																																				
Assemb/review/revise draft report																																				
Publish final report																																				

Measures of Progress

1.2 Area of Concern Beneficial Use Impairments removed.

The main objective of this study is to determine if the benthos beneficial use is, or is not impaired in parts of the Rochester Embayment AOC. Benthic macroinvertebrate community data and bed sediment-toxicity test results will be used specifically to test whether bed sediments in the Rochester Embayment AOC meet both established criteria (see above) for delisting the benthos BUI.

In general, the USGS and NYSDEC propose to:

1. Seek consensus on a work plan based on input from stakeholders;
2. Select target locations for benthic-community surveys and bed sediment samples; finalize study sites;
3. Identify toxicity and taxonomic labs, request bids, assemble whole-sediment testing and identify contracts;
4. let contracts, and finalize work plan and logistics;
5. Reconnoiter sample sites and evaluate accessibility, sampling procedures, and bottom bed sediments;
6. Collect benthic-community (5x) and whole-sediment (1x) toxicity samples from 15 to 30 study sites **once** during late spring or early summer of 2013 (collect a duplicate set of whole-sediment toxicity samples from two sites for quality assurance purposes);
7. Conduct 10-day acute (survival) and chronic (growth) bioassays (via subcontract) with *Chironomus dilutus* following standard methods (ASTM 2010; USEPA 1994; USEPA 2000) *for composite whole-sediment samples collected at each study site*;
8. Process 100-organism (macroinvertebrate) subsamples from each Petite Ponar sample and identify individuals to the lowest possible taxon;
9. Verify and summarize benthic-community and whole-sediment toxicity data and test the two main hypotheses;
10. Assess results, assemble a draft USGS open file report, and obtain technical and editorial reviews; and
11. Revise draft report and publish the final version either as a journal article or electronically on the World Wide Web.

Collaborative Arrangements

Field and laboratory work will be done in collaboration with the New York State Department of Environmental Conservation and all work will be coordinated with EPA Region 2 staff.

Budget Information

Personnel	\$ 54,381
Fringe Benefits	\$ 6,109
Travel	\$ 3,864
Equipment	\$ 2,147
Supplies	\$ 0
Contracts	\$ 0
Other	\$ 0
Indirect Costs	\$ 3,499
Total	\$ 70,000

Template 146c - Sediment Toxicity and Status of Benthic Invertebrate Communities in the St. Lawrence River and its Tributaries within the Massena Area of Concern

Total funding: \$45,022

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The approach of this study will be to generate bed sediment toxicity and benthic community data needed to test two related hypotheses that address the two criteria for delisting the benthos BUI. The *first hypothesis* is that bed sediments at selected sample locations in the AOC (in three tributaries and in the St. Lawrence River) are no more toxic to the test species than bed sediments collected from control sites located outside (generally upstream from) the AOC. Acute (survival) and chronic (growth) whole bed-sediment toxicity tests will be conducted using the midge (*Chironomus dilutus*), following standard methods (USEPA 1994; USEPA 2000). The *second hypothesis* is that the benthic macroinvertebrate communities from targeted sites within the AOC are not significantly different, or are affected (impacted) no more seriously than the communities encountered at reference (control) sites located outside the AOC according to spatial patterns in benthic community composition (nonparametric ordination) and the Biological Assessment Profile (BAP) index and component metrics for Ponar samples collected from soft bed sediments (fig. 1) developed by NY State Department of Environmental Conservation (Bode et al. 2002; Smith et al. 2009). The component metrics of the BAP include: SPP (species richness), HBI (Hilsenhoff Biotic Index), DOM3 (Dominance-3), PMA (Percent Model Affinity), and DIV (species diversity). The mean score of the five indices denotes the overall BAP and associated impact for each site.

Although several bed sediment-collection methods are suitable, the Petite Ponar sampler will be used to collect 5 replicate macroinvertebrate-community samples and a single composite sample

for bed sediment toxicity tests at each study site. Bed-sediment sizes will be characterized by either the U.S. Geological Survey (USGS) Sediment Laboratory or NYSDEC subcontract laboratory using a subsample (split) obtained from the composite bed sediment-toxicity sample. Statistical analyses and multivariate (ordination) methods will be used to test the two hypotheses and to determine if the bed sediments within the St. Lawrence River at Massena AOC meet either criterion for delisting the benthos BUI.

Milestones

Project timeline: A provisional timeline, which shows the estimated periods (or window of time) when task components are scheduled to be conducted, is provided below.

No.	Task Description	Fiscal Year One												Fiscal Year Two												Fiscal Year Three													
		o	n	d	j	f	m	a	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s	o	n	d	j	f	m	a	m	j	j	a	s		
1	Assemb workplan																																						
2	Select study sites																																						
3	ID taxon & toxic labs																																						
4	Recon sites/methods																																						
5	Collect bug/sedi samples																																						
6	Conduct bioassays																																						
7	Process invert samples																																						
8	Verify and summ toxic & taxon data																																						
9	Assemb/review/revise draft report																																						
10	Publish final report																																						
11																																							

Measures of Progress

1.2 Area of Concern Beneficial Use Impairments removed.

The objective of this study is to determine if the benthos beneficial use is, or is not impaired in parts of the St. Lawrence River at Massena AOC. Benthic macroinvertebrate community data and bed sediment-toxicity test results will be used specifically to test whether bed sediments in the St. Lawrence River at Massena AOC meet established criteria (see above) for delisting the benthos BUI.

In general, the USGS and NYSDEC propose to:

1. Seek consensus on a work plan based on input from stakeholders;
2. Select target locations for benthic-community surveys and bed sediment samples; finalize study sites;
3. Identify toxicity and taxonomic labs, request for bids, assemble whole-sediment testing and identification contracts;
4. Let contracts, and finalize work plan and logistics;
5. Reconnoiter sample sites and valuate accessibility, sampling procedures, and bottom bed sediments;
6. Collect benthic-community (5x) and whole-sediment (1x) toxicity samples from as many as 30 study sites during late spring or early summer of 2012 (collect a duplicate set of whole-sediment toxicity samples from two sites for quality assurance purposes);

7. Conduct 10-day acute (survival) and chronic (growth) bioassays (via subcontract) with *Chironomus dilutus* following standard methods (ASTM 2010; USEPA 1994; USEPA 2000) for composite whole-sediment samples collected at each site;
8. Process 100-organism (macroinvertebrate) subsamples from each Petite Ponar sample and identify individuals to the lowest possible taxon;
9. Verify and summarize benthic-community and whole-sediment toxicity data and test the two main hypotheses;
10. Assess results, assemble a draft USGS open file report, and obtain technical and editorial reviews; and
11. Revise draft report and publish the final version electronically on the World Wide Web.

Collaborative Arrangements

Field and laboratory work will be done in collaboration with the New York State Department of Environmental Conservation and all work will be coordinated with EPA Region 2 staff.

Budget Information

Personnel	\$ 27,490
Fringe Benefits	\$ 9,163
Travel	\$ 2,898
Equipment	\$ 3,220
Contracts	\$ 0
Cooperative Agreements	\$ 0
Indirect Costs	\$ 2,251
Total	\$ 45,022

Template 146d - Determining sources of bacterial contamination at Jearse Park Beach (Phase I and II), in the Grand Calumet River AOC

Phase I (FY12) -- Source Identification

Phase II (FY13) -- Current Modeling/Fate of Contamination

Total funding: \$80,000 FY12
 \$91,000 FY13

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Jearse Park Beach is located in East Chicago, Indiana, within the Grand Calumet River Area of Concern, which has been identified as having all 14 beneficial use designations impaired, including beach closings. Jearse Park Beach has been identified as one of the most highly contaminated beaches in the nation, with annual beach closings due to bacterial contamination as high as 76% in 2010. Further, beach closings have steadily increased each year since beach monitoring was initiated in 2005 in response to the Beaches Environmental and Coastal Health (BEACH) Act. Beach closings represent an environmental, social, and economic burden, the

alleviation of which require various remediation strategies targeted to specific sources of microbiological contamination.

Research by USGS at Jearse Park Beach in cooperation with the State of Indiana has identified dual factors contributing to beach closings: (1) the enclosed circulation of the beach area prevents contaminants from moving out of the embayment and (2) resident shore birds (geese, gulls) are a significant source of fecal contamination to the swimming water. In addition to bird contamination, evidence of human sewage contamination has also been found at this beach. The presence of additional sources of contamination, originating within or outside of the beach, and the influence of beach circulation patterns on retaining and influencing the persistence of these bacteria remain unknown.

Objectives and Scope – In this study, we propose to investigate the sources of high concentrations of indicator bacteria at Jearse Park Beach and the relative influence of these potentially varied sources on beach water quality. . If these rivers are releasing high concentrations of bacteria into the lake, there is a potential for nearshore currents to carry these contaminants to the Jearse Park Beach, where they may become trapped in by embayment circulation patterns in the nearshore.

Relevance/Benefits – An improvement in water quality would directly benefit the Grand Calumet River Area of Concern by helping to remove the impaired beneficial use designation of beach closings. The issues of beach closings, resident bird sources, and lack of circulation are common management issues, but without defined results, beach managers are unable to relate activities to reductions in bacterial contamination. With the results of this project, beach managers will have the necessary tools to pursue remediation of contaminants and therefore reduce the number of beach closings. Because of the frequency of the problem, results of this project could be transferred to benefit hundreds of beaches throughout the Great Lakes and coastal waters nationally. Benefits of a reduction in beach closures include decreased human health risk, increased recreational access, and the promotion of economic opportunities.

Approach -

Water samples will be collected at Jearse Park beach, at the two river outfalls, and in the lake on either side of the outfalls in order to connect the hydrodynamic model with the bacteria contamination source. These samples will be analyzed for molecular markers of human sewage contamination and gull contamination and also for culturable *E. coli*. If the rivers are identified as likely sources of contamination to Jearse Park Beach, remediation actions will be suggested.

Milestones

Results of this project will be reported to the AOC Care Committee, the RAP coordinator and, also, disseminated through other local and national scientific meetings, such as the Great Lakes Beach Association and the National Beach Conference, as well as in peer-reviewed scientific literature. Results will be of significant importance to beach managers throughout the Great Lakes and particularly to management agencies in Areas of Concern with beach closings as beneficial use impairment.

- Final Project Scoping with AOC Care Committee Spring 2012

- Microbial Source Tracking Analysis Winter and Spring 2012
- Analyses of fecal indicator bacteria at streams and beach 2012
- Interim Report on Phase I completion.

Measures of Progress

1.2 Area of Concern Beneficial Use Impairments removed.

3.2 Percentage of beaches meeting bacteria standards 95% or more of beach days.

Work funded by this template will provide the information needed to remove the beach closing BUI at Jeorse Park Beach in the Grand Calumet River AOC. This project also directly supports the achievement of Measures of Progress 2 and 4 of Focus Area 3: Nearshore Health and Nonpoint Source Pollution as Defined in the Great Lakes Restoration Initiative Action Plan.

Collaborative Arrangements

The principal collaborators for this work are the AOC Care Committee for the Grand Calumet River Area of Concern, the State of Indiana, and East Chicago, Indiana.

Budget Information

Personnel	\$9,600
Fringe Benefits	\$2,400
Travel	\$2,000
Equipment and supplies	\$7,000
Contracts	\$55,000
Indirect Costs	\$4,000
Total	\$80,000

Template 147 - Development of Critical Information

Total funding: \$493,000

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Task 1a. Examination of the effect of chloride on the acute and chronic toxicity of nitrate using *Ceriodaphnia dubia* and *Hyaella azteca* (\$108,000 gross funding). It has been well established that increasing chloride concentration in water reduces the toxicity of nitrite (NO₂) to invertebrates, including crayfish, amphipods, and midges. Increased chloride concentrations have also been shown to ameliorate fluoride toxicity to net-spinning caddisflies, and sulfate toxicity to the amphipod *Hyaella azteca*. No work has been done to characterize the effects of chloride concentration on nitrate (NO₃) toxicity, but anecdotal evidence of an effect may exist in the fact that the chronic effects of NO₃ reported for the cladoceran *Ceriodaphnia dubia* by Scott and Crunkilton (2000: *Environ Toxicol Chem* 19:2918-2922) using a water with chloride of

about 2 to 4 mg/L were observed at concentrations about 14 fold lower than those observed in a recent test conducted at the Illinois Natural History Survey (INHS) using a water with about 34 mg/L chloride. To develop the most accurate water quality standard possible for NO₃, it is necessary to characterize the relationship between ambient chloride concentration and acute and chronic NO₃ toxicity. Toxicity testing will be conducted with *C. dubia* and *H. azteca* as test organisms. Acute NO₃ toxicity tests will be conducted with both species at about five different chloride concentrations spanning the natural range of chloride concentrations in surface waters of EPA Region 5. Chronic NO₃ toxicity tests will also be conducted with both organisms using a subset of the chloride concentrations used in the acute tests. Results of this study provide data that could be used by EPA to help develop or refine state standards or national criteria for NO₃.

Task 1b. Influence of water hardness on the chronic toxicity of sulfate and chloride to fathead minnows (*Pimephales promelas*) and cladocerans (*Ceriodaphnia dubia*; \$210,000 gross funding). USGS-Columbia has completed a series of acute and chronic sulfate toxicity tests with a variety of test organisms including fathead minnows, cladocerans, mussels, and midge. Results of the study indicate that fathead minnows and cladocerans were the most sensitive test organisms; however, testing was only conducted at one level of water hardness. Similarly, chronic toxicity data for chloride are available for a limited number of species (primarily cladocerans, fathead minnows, and trout). Published studies have documented a protective effect of water hardness on sulfate or chloride toxicity, but these studies have primary been short-term exposures. The objective of this study will be to evaluate influence of three levels of water hardness on the chronic toxicity of sulfate or chloride to fathead minnows in 34-day early life stage exposures and to cladocerans in 7-day exposures. Levels of water hardness to be tested will be selected to be representative of the range of water quality conditions across the Great Lakes. Endpoints to be evaluated will include hatching, survival, length, weight and biomass of fathead minnows, and survival and reproduction of cladocerans. Results of this study will determine if there is an influence of water quality on the chronic toxicity of sulfate or chloride, rather than extrapolating these relationships from toxicity data generated from short-term exposures. Results of this study will provide data that could be used by EPA to help develop or refine state standards or national criteria for sulfate or chloride.

Task 1c. Evaluation of the effects of calcium or potassium as toxicants and their influence on the toxicity of other anions (\$175,000 gross funding). The toxicity of potassium or calcium to select aquatic organism has been evaluated primarily in acute exposures. The objective of this study will be to conduct acute or chronic potassium or calcium toxicity tests with a variety of aquatic organisms (e.g., fathead minnow, *Ceriodaphnia dubia*, mussels, amphipods, midge, and mayflies). All testing will be conducted on one base water (e.g., initial hardness of diluted well water of 100 mg/L as CaCO₃, varying the major anions associated with either calcium or potassium (e.g., chloride, sulfate)). Endpoints to be evaluated will include hatching, survival, length, weight, biomass, or reproduction (depending on the species tested). Results of this study will determine acute to chronic ratios that could be used by EPA to help develop state standards or national criteria for potassium or calcium.

Milestones

Studies will be conducted in 2012 and 2013 and a final report will be provided to EPA in 2013 in the form of draft manuscripts for submission to a scientific journal(s).

Measures of Progress

1.2 Area of Concern Beneficial Use Impairments removed.

1.5 Pollution collected through prevention and waste minimization projects in the Great Lakes basin.

Tasks 1a, 1b, and 1c will provide data to help EPA refine existing state standards or develop new state standards for major cations or major anions including nitrate, chloride, sulfate, potassium, and calcium. These standards will address Focus Area 1: Toxic Substances and Areas of Concern (including pollution prevention and cleanup of the most polluted areas in the Great Lakes) and Focus Area 3: Nearshore Health and Nonpoint Source Pollution (including a targeted geographic focus on high priority watersheds and reducing polluted runoff from urban, suburban and, agricultural sources).

Collaborative Arrangements

Task 1a will be conducted under a cooperative agreement with Dr. Dave Soucek at the Illinois Natural History Survey at the University of Illinois at Urbana-Champaign in Illinois IL; d-soucek@forbes.inhs.uiuc.edu).

Budget Information

Personnel	\$ 264,027
Fringe Benefits	\$ 113,154
Travel	\$ 4,000
Equipment	\$ 0
Contracts	\$ 0
Cooperative Agreements	\$ 87,169
Indirect Costs	\$ 24,650
Total	\$ 493,000

Template 370 - Riparian Indicators of Contaminant Exposure to Support Delisting of AOCs and Removal of Beneficial Use Impairments

Total Funding \$250,000

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

This project will quantify contaminant exposure in riparian food webs and identify robust sentinels of ecosystem recovery in order facilitate delisting of AOCs and to remove beneficial use impairments (BUIs). These data will be used to evaluate BUIs, to evaluate the relationship between sediment contamination and adverse biological exposures, and to identify areas that require additional source control and or active remediation efforts. Research will focus on 5 potential sites, with the goal of working on 1-2 sites eligible for delisting from 2012 to 2014.

Work will focus on evaluating ongoing BUI impacts and identifying potential ongoing sources of contamination that require additional management actions to delist AOCs.

Candidate AOCs for this research include Manistique River and Harbor (PCBs) Waukegan Harbor (PCBs), Ashtabula River (PCBs and other contaminants), Raisin River (PCBs), and Muskegon Lake (Hg). Based on consultation with GLNPO scientists and site project managers, FY2012 research will target Manistique and Ashtabula AOCs. US EPA (GLNPO and ORD) and other Federal, State, and Local agencies may also collect additional data on contaminant concentrations in water, sediment, and biota at these sites. When possible, we will coordinate with these agencies to leverage these efforts and to develop more complete conceptual site models and models of exposure in aquatic and riparian food webs. This approach will allow us to identify additional exposure endpoints that can be used to assess and monitor contaminant levels at temporal and spatial scales relevant to GLNPO delisting goals.

Spider species for these contaminant exposure studies will be tetragnathid (long jawed spiders) and araneid (orb-weaving spiders). We will also sample adult aquatic insects, terrestrial insects and other terrestrial arthropods, in order to develop food web models of contaminant transfer and to confirm that the pathway of exposure is from contaminated aquatic sediments. In particular, spider concentrations will be compared to local sediment concentrations in order to develop empirical models of exposure and to set the baseline for monitoring future changes in site condition and/or organism exposure. These data will also be used to develop spatially extensive exposure risk maps of surveyed areas.

Work at Manistique Harbor will extend results of FY2011 riparian/site characterization studies that have already been communicated to AOC project managers and the interagency Manistique AOC Project Team. In addition to riparian studies at Manistique AOC, we will also sample a variety of physical and chemical tracers (temperature, DO, metals, stable isotopes, various forms of carbon, metals, etc.) to help characterize important hydrological processes that are linked to PCB fate and transport. The Manistique AOC is a complex mosaic of river, backwater slough, harbor, and lake habitats. Processes driving the movement of contaminants and organisms among these sites will be identified to better characterize contaminant flux among these compartments and to guide remedial design and site monitoring. Work at Ashtabula AOC will focus on chemical analyses of riparian samples collected in FY2011.

Milestones

1. Study sites selected, contracts with analytical laboratories in place, field crews ready and trained, supplies purchased and available, field collection ready to begin; April, 2012.
2. Field collections completed, sample databases prepared, samples shipped to chemical laboratories; Summer, 2012
3. Data analysis, compilation, and summarization begins; September, 2012. GLNPO site manager preliminary briefing, January, 2013.
4. Data analysis, compilation, reporting and GLNPO site manager final briefing; September, 2013.

Measures of Progress

1.2 Area of Concern Beneficial Use Impairments removed.

Supports Goal 1: AOCs are cleaned up, restoring areas and removing BUIs and Goal 3: Exposure to toxic substances from historically contaminated sources is significantly reduced through source reduction and other exposure reduction methods.

Specific BUIs addressed by this research are:

1. Degradation of fish and wildlife populations
2. Degradation of benthos (riparian predators consume contaminated aquatic insects that originate in the benthos)
3. Restrictions on dredging (measurement of sediment PCB concentrations).

AOC managers can use data provided by these studies as:

1. Baseline monitoring to establish current BUI conditions and/or determine delisting criteria
2. Pre-remedial data to help with design of remedial action
3. Verification data to establish that BUI removal criteria have been met.

Collaborative Arrangements

USGS will work with State and local partners to develop the information needed to support BUI removal.

Budget Information

Personnel	\$ 79,000
Fringe Benefits	\$ 19,000
Travel	\$ 20,000
Equipment	\$ 0
Supplies	\$ 9,000
Contracts	\$ 96,500
Other	\$ 14,000
Indirect Costs	\$ 12,500
Total	\$ 250,000

Template 384 - USGS support for AOC Delisting (Decision Support for BUI removal)

Total Funding: \$126,565

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Areas of Concern (AOC) principles and guidelines were developed as an initial reference point from which appropriate restoration criteria could be developed. Stage 2 Remedial Action Plans (RAPs) were developed for each of these AOCs to address impairments to any one of 14

beneficial uses associated with these areas. Specific remediation actions are completed in order to restore the beneficial use. When monitoring data shows a beneficial use is no longer impaired, the state and EPA can remove that BUI. When data shows all identified beneficial use impairments have been eliminated, the EPA can submit a proposal to the International Joint Commission (IJC) for removing the designation of AOC in its entirety. Background information is available at these websites:

1. <http://www.ijc.org/rel/boards/annex2/buis.htm#table1#table1>
2. http://www.ijc.org/rel/boards/annex2/aoc_php/bui_targets.php?bui=Restrictions%20on%20Fish%20and%20Wildlife%20Consumption
3. http://www.ijc.org/rel/boards/annex2/aoc_php/bui_area.php?aocid=2001&nation=USA
4. <http://epa.gov/glnpo/aoc/>

Specific information and measureable indicators are needed in order to demonstrate restoration of the beneficial use. The USGS will meet with State partners, and others, to develop a scientific framework to support decision needs specific to the AOCs. This may include: determining appropriate measureable indicators, compilation of existing data and information, defining reference conditions, development of decision support framework, discussion of monitoring needed, etc.

The Beneficial Use Impairments (BUIs) where USGS will be most likely to be of help are: Fish consumption advisories, fish tumor presence, Eutrophication and unwanted algae, drinking water problems, beach health, and concentrations of PCBs in lake trout and walleyes. The other area that we can and are providing support is in assessing new toxic threats.

Milestones

Meet with State and AOC coordinators to discuss details of BUIs and ideas for support the USGS can provide. Based on these meetings, develop decision support needs for specific AOCs, focusing on tier 1 and tier 2 during FY 2013.

Measures of Progress

1.2 Area of Concern Beneficial Use Impairments removed.

Collaborative Arrangements

USGS will work with State and local partners to develop the tools needed to support BUI delisting. Project will also leverage USGS GLRI database and internet mapping work associated with GLOS, database, and LaMP projects and data being collected in other USGS GLRI projects.

Budget Information

Personnel	\$ 86,428
Fringe Benefits	\$ 28,809
Travel	\$ 5,000
Equipment	\$ 0
Contracts	\$ 0
Cooperative Agreements	\$ 0

Lab Analyses	\$ 0
Indirect	\$ 6,328
Total	\$ 126,565

Invasive Species

Template 67 - Innovative *Phragmites* Control Strategies

Total funding: \$253,130

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Phragmites has colonized many marshes throughout the eastern United States, is rapidly invading Areas of Concern (AOC) and the few remaining marshes in the Great Lakes, and has spread to the Pacific coast, where it is displacing local vegetation. Current control strategies are time, labor, and resource intensive, so innovative methods to control the spread of *Phragmites* or minimize its invasive properties are needed. This study is testing new strategies to reduce the invasive properties of *Phragmites* and minimize its competitive advantage over native and recently restored vegetation. This project will target the organisms that may help *Phragmites* spread and will employ a molecular genetic approach to silence the genes in *Phragmites* that allow it to reproduce and grow. This work involves researchers from the USGS – Great Lakes Science Center, Wayne State University, University of Washington, USGS - Western Fisheries Research Center, and State University of New York – Brockport.

This project is more than a *Phragmites* control project. It is a groundbreaking invasive species control project that has direct benefits to restoration efforts nationwide and even globally. The project has obtained *Phragmites* rhizomes and started a greenhouse population for endophyte studies. FY 2010 experiments have been expanded to include white top mustard (*Cardaria draba*), bulbous blue grass (*Poa bulbosa*), Kochia (*Kochia scoparia*), Diffuse knapweed (*Centaurea diffusa*), Yellow star thistle (*Centaurea solstitialis*), and Spotted knapweed (*Centaurea maculosa*). Endophytes are targeted with fungicides to determine their role in invasion. Thus far, white top has experienced a 20% reduction in growth. Endophytes have been isolated from *Phragmites* plants and are being screened for fungicide sensitivity in FY 2012. Greenhouse testing of endophytes will continue in preparation to move experiments to field sites located in AOCs.

Progress has also been made in gene silencing techniques. Multiple sets of degenerative primers have been designed for genes associated with *Phragmites* photosynthesis, root development and reproduction. A new vector named pWSRi (Plasma Wayne State RNA Interference) was developed to deliver the gene of interest (e.g., seed production) to a *Phragmites* plant. Several *Phragmites* genes and delivery vectors are being tested in the Wayne State laboratory in preparation of field experiments into FY 2012. These results and the overall direction of this project directly support the broader Integrated Pest Management (IPM) approach being developed for *Phragmites* and many other invasive plants. There are many opportunities to work with the existing partners (e.g., SEMCOG, USFWS, TNC, GLC, DU) to build on this work, integrate with IPM efforts, and target our field trials in AOCs or other high priority sites.

Milestones

Results of this project will be used to guide future proposals focused on potential implementation strategies for using successful techniques to control the invasive *Phragmites* haplotype M. Those experiments would include evaluation of collateral impacts on native species. Specific milestones are as follows:

1. Identification of fungal endophytes in *Phragmites*, June 2011 Screening endophytes for fungicide sensitivity, March 2012
2. Generate a new vector specifically for *Phragmites* derived from a monocot-targeted virus and test it against the current *pWSRi* vector, March 2012
3. Test how invasive plants can be managed by killing endophytes using specifically designed solutions, May 2012
4. Continue greenhouse testing of endophytes and move experiments to field sites located in AOCs, July 2012
5. Test endophytes for the ability to use methane as a carbon sources, which has implications for climate change issues, July 2012
6. Explore regulatory hurdles for implementation of new control strategies, September 2012
7. Prepare for field experiments on gene silencing techniques at sites in AOCs, September 2012
8. Communicate project results to the public and decision makers through presentations, web pages, fact sheets, and peer-reviewed manuscripts (9 presentations given in 2011), September 2012

Measures of Progress

2.2 Acres managed for populations of invasive species controlled to a target level.

1.2 Area of Concern Beneficial Use Impairments removed.

Phragmites is an invasive plant that continues to spread throughout the Great Lakes and have negative impacts on coastal resources including critical fish and wildlife habitat and coastal viewscapes. *Phragmites* is also a major problem in most AOCs, so this project will benefit habitat restoration projects and other efforts to improve Beneficial Use Impairments (BUIs). This project also addresses priority issues in the EPA directed Lakewide Management Plans for Lakes Huron and Erie, including restoring fish habitats, rehabilitation of nearshore habitats, reduce invasive species impacts, and protect island habitats.

Relevance to GLRI Action Plan

Focus Area 1: Toxic Substances and Areas of Concern

This project is focused on developing sustainable control measures for invasive plant species with a particular focus on the invasive *Phragmites australis*. *Phragmites* is well established in most AOCs and invasion often results in the degradation of aesthetics and loss of critical fish and wildlife habitat (identified impairments), so this project is addressing Long-Term Goal 1 (Areas of Concern are cleaned up, restoring the areas and removing the beneficial use impairments). If successful control measures are developed, they could be implemented in AOCs and support the removal of beneficial use impairments in AOCs across the basin.

Focus Area 2: Invasive Species

Outputs and outcomes from this project could reduce the spread of invasive species beyond their current range (Long-Term Goal 3) by providing landowners and land managers new tools for managing and controlling invasive species before they become established. The project also contributes to an environmentally sound program of integrated pest management for invasive species (Long-Term Goal 5) by developing new measures to contain, eradicate, and control target species. More specifically, this project directly supports the “Principal Actions to Achieve Progress” by developing and demonstrating innovative control technology that could significantly reduce the cost and/or increase the effectiveness of species control measures.

Focus Area 4: Habitat and Wildlife Protection and Restoration

This project involves restoration of Great Lakes aquatic habitats by targeting invasive species control measures that will allow the restoration of wetland ecosystem functions and improvement of conditions for native fish and wildlife (Long-Term Goal 1). The project also supports Long-Term Goal 4 because the work is in line with the invasive species and other management priorities of the Lakewide Management Plans, resource management agencies (e.g., USFWS), the Nature Conservancy, and private resource managers.

Collaborative Arrangements

This work involves researchers from the USGS – Great Lakes Science Center, Wayne State University, University of Washington, USGS - Western Fisheries Research Center, and State University of New York – Brockport.

Budget Information

Personnel	\$ 85,739
Fringe Benefits	\$ 21,434
Travel	\$ 8,000
Equipment	\$ 13,500
Contracts	\$ 111,800
Cooperative Agreements	\$ 0
Indirect Costs	\$ 12,657
Total	\$ 253,130

Template 673 - Asian Carp Control

Template Overview

This template includes activities associated with projects 2.3.1, 2.4.7, 2.5.3, 2.5.6, 2.5.17, 2.5.19, 2.5.21, 2.6.3, and 2.6.5 of the Asian Carp Control Strategy Framework (February 2012).

Purpose

To contribute to the overall restoration of desired ecological conditions within the Great Lakes and to prevent the further expansion of Asian carps in the Great Lakes Basin.

To evaluate alternate pathways for the invasive Asian carps to move from the Mississippi River watershed into the Great Lakes and to provide hydraulic information needed for correct delivery of biocides to select areas as well as to understand surface-water flow under flood conditions.

Great Lakes tributaries will be evaluated that could provide potential spawning opportunities along with potential methods to disrupt spawning aggregations and recruitment.

Asian Carp Framework 2.3.1 – USGS Support of USACE By-Pass Barrier Operations

Total Funding: \$75,000

Authority for work: USGS Organic Act 43 U.S.C. 31, the General Cooperation Authority 43 U.S.C. 36c, and the Water Resources Research Act of 1984 – 42 USC 10303 (h)(1)(D)

Description of Work

USACE applies three different types of fish deterrent measures throughout the CAWS. Each measure is designed to prevent a distinct migration pathway of Asian carp toward the Great Lakes. These measures are:

1. The Bypass Barrier physically blocks known bypasses around the electric barriers that occur during periods of flooding from the Des Plaines River and the Illinois and Michigan (I&M) Canal, and halts possible fish movement through this area. The barriers placed in these locations are intended to stop juvenile and adult Asian carp. Additional and/or more permanent separation measures will be assessed in the Efficacy Study Report.
2. The Electric Barriers create a waterborne, pulsed, direct current, electric field in the Chicago Sanitary and Ship Canal (CSSC), which exposes fish penetrating the electric field to electrical stimuli that act as a deterrent. As fish swim into the field, they feel increasingly uncomfortable. When the sensation is too intense, the fish are either immobilized or deterred from progressing farther into the field. Three barriers (Demo, IIA, and IIB) have been constructed so that two can operate fully at any given time and the third is available for emergencies or planned maintenance shutdown.
3. Bar screens on sluice gates at Thomas J. O'Brien Lock and Dam were installed to impede entry of Asian carp to Lake Michigan. All potential impacts were considered to ensure public health and safety, and the purposes of these structures must be maintained as authorized by law. USGS scientists will use seismic waterguns to assist fish suppression for USACE during electric barrier planned or emergency maintenance.

Because of the ongoing nature of this work, it is non-severable.

Milestones

USGS scientists will deploy seismic waterguns as necessary to support USACE planned maintenance as well as possible emergency shutdowns.

Measures of Progress

2.3 Number multi-agency plans established, mock exercises to practice rapid responses carried out under those plans, and/or actual rapid response actions.

Deployment of seismic waterguns will help assure that the electric barriers will perform as designed, thereby minimizing the risk of bypass around the electric barriers via the I & M Canal and the Des Plaines River.

Collaborative Arrangements

USGS support for USACE barrier maintenance and continued operations.

Budget Information

Personnel	\$ 44,482
Fringe Benefits	\$ 14,828
Travel	\$10,000
Equipment	\$ 2,000
Contracts	\$ 0
Indirect Costs	\$ 3,690
Total	\$ 75,000

Asian Carp Framework 2.4.7 - Wabash-Maumee Hydrologic Support to Prevent Interbasin Transfer of Asian Carp

Total funding: \$85,000

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c, and the Water Resources Research Act of 1984 – 42 USC 10303 (h)(1)(D)

Description of Work

Adult bighead carp have been a confirmed presence in the Wabash River basin for at least 15 years. The Wabash River basin intermittently connects with the Maumee Basin (Lake Erie) through a former glacial channel at Eagle Marsh near Fort Wayne, Ind. during flood stage. This project collects streamflow and temperature data collection in major streams near Eagle Marsh to provide data to support streamflow and inundation modeling efforts by the Corps of Engineers (USACE). Data from this project will support development of feasible plans to separate the basins to limit migration of Aquatic Nuisance Species while maintaining Eagle Marsh as viable flood relief for Fort Wayne, Ind.

The work in FY 2012 is composed of two major elements:

1. Operate two existing stage gages at the Asian Carp Barrier Fence in Eagle Marsh for one year to indicate periods when Eagle Marsh floods sufficiently for the adult carp barrier fence to operate and to indicate needs for barrier maintenance and cleaning.
2. Install two additional hydroacoustic streamflow and temperature gages and operate both for one year on Graham-McCullough Ditch and on Little River or Junk Ditch to establish flow properties to model effect of proposed basin separation on flooding.

Because of the ongoing nature of this work, it is non-severable.

Milestones

- Order equipment and procure shelters for gage installations (One month after funding received)
- Develop gage site agreements and obtain permissions for gage installations (Two months after funding received)
- Install streamflow gages at two sites (two-three months after funding released.
 - Graham McCullough Ditch near where it empties into Little River and
 - Site on Little River below confluence with Aboite Creek or Junk Ditch near mouth at St. Mary's River.
- Stations to go online approximately three months after funds approved
- Develop stage-discharge rating for two gages to rate stream and release streamflow data (6 months after start of gage operation).
- Publish provisional streamflow and temperature data to USGS NWIS-Web and provide information to USACE and IDNR partners for effective use in hydraulic simulation of ANS separation alternatives. Initial data released to internet will be water level and temperature
- Provide provisional streamflow and temperature information online, one year after installation.
- Continue operation of stage-only gages at Eagle Marsh for one year, October 1, 2011 to September 30, 2012 (FY 2012)

Measures of Progress

2.3 Number multi-agency plans established, mock exercises to practice rapid responses carried out under those plans, and/or actual rapid response actions

USGS operation of the water-level sensors (stage gages) at the temporary Asian Carp Barrier Fence at Eagle Marsh triggered two rapid response actions during high water events in June-July and in December 2011. Those events produced ponded water at the fence that was sufficient for Asian carp, if nearby, to reach the fence. The rapid response inspection in June-July was done by Indiana DNR and Little River Wetland Project (LRWP) personnel and the response inspection in December was made by LRWP personnel only. We anticipate that in FY 2012 and 2013 with suitably wet weather conditions that the USGS water-level sensors may identify from 1 to 4 water-level conditions per year that trigger a rapid response inspection to observe whether adult or juvenile silver or bighead carp are present and obstructed by the Barrier Fence.

Implement Early Actions to Address Water Pathways Vectors – Identify key waterways that could introduce ANS to the Great Lakes and implement actions such as ecological separation to reduce this risk. The USGS installation and planned two year collection of streamflow and water temperature data from streams near Eagle Marsh will provide necessary data to refine flow and inundation models and analysis of hydrological connections under different weather conditions. These results will contribute to the ultimate separation Eagle Marsh of the intermittent connection between the Mississippi River Basin (MRB, Wabash River) and Great Lakes Basin (GLB, St. Mary's and Maumee Rivers). The data will assist with the design of a permanent separation that will prevent aquatic nuisance species (ANS) from unassisted movement between

basins. Eagle Marsh is the second highest priority for hydrologic separation to prevent ANS movement between the MRB and GLB.

Collaborative Arrangements

The USGS will consult with the Indiana Department of Natural Resources (DNR) and the U.S. Army Corps of Engineers, Louisville District to identify sites for gage installation that provide streamflow and temperature data that are needed to validate hydrologic models used for barrier or separation design. The USGS also coordinates operation of the water level (stage) gages at the Asian Carp Barrier Fence in Eagle Marsh with rapid response and maintenance actions by the Little River Wetland Project and the Indiana DNR. Those entities provide field inspections for Asian carp when water levels rise and the fence operates and when the fence needs maintenance or cleaning.

Budget Information

Personnel	\$ 37,125
Fringe Benefits	\$ 7,795
Travel	\$ 3,550
Equipment	\$ 32,280
Contracts	\$ 0
Indirect Costs	\$ 4,250
Total Costs	\$ 85,000

Asian Carp Framework 2.5.3 - Research on the Impacts of Potential Asian Carp Vectors Being a Source of Fish or eDNA Movement in the CAWS

Funding Amount: \$200,000

Authority for work: USGS Organic Act 43 U.S.C. 31, the General Cooperation Authority 43 U.S.C. 36c, and the Water Resources Research Act of 1984 – 42 USC 10303 (h)(1)(D)

Description of Work

Piscivorous birds readily consume Asian carp (AC) in areas where the AC population is high, particularly downstream of the CAWS or in the Des Plaines River, and can easily move between these systems and locations upstream of the dispersion barrier on the CAWS. Dead silver carp have also been observed on the decks of barges moving throughout the CAWS, including upstream through the dispersion barrier. Both sources (piscivorous birds and carcasses) are potential vectors of AC DNA. The goals of this research are to evaluate the potential that: 1) piscivorous birds and 2) carcasses are sources of AC DNA in environmental DNA (eDNA) samples. This project is part of a much larger project that is evaluating several potential vectors of AC eDNA.

The U.S. Geological Survey Upper Midwest Environmental Sciences Center (UMESC) will determine whether AC DNA passes through the digestive system of piscivorous birds in a form that is detectable through standard eDNA monitoring protocols. Piscivorous birds will be

retained in enclosed ponds and fed diets containing fresh AC. Fecal material will be collected, DNA extracted and subsequently analyzed for the presence of AC DNA. Water samples will be collected from the holding pond(s) prior to the addition of the birds, immediately after adding the birds, and then weekly after feeding begins. All water samples will be processed according to a standard eDNA protocol to determine the presence/absence of AC eDNA.

Scientists at UMESC are also tasked with determining whether AC carcasses present on barges are a potential source of AC eDNA in the CAWS. A known mass of dead silver carp and bighead carp will be suspended above the pond water surface in such a fashion that only the liquid from the putrefying remains will enter the pond. Liquids from the putrefying remains will be collected weekly and the remaining DNA will be extracted and analyzed to determine the presence/absence of intact AC DNA. Water samples will be collected from the holding pond(s) prior to the addition of the carcasses, immediately after adding the carcasses, and then weekly thereafter. Water samples will be processed according to a standard eDNA protocol to determine the presence/absence of AC eDNA.

Milestones

Birds as vectors:

- June/July 2012 – Collect piscivorous birds and transport to covered ponds at UMESC
- June/July 2012 – Begin feeding birds silver carp and/or bighead carp
- September 2012 – Conclude collection of fecal material from birds
- November 2012 – Process data
- December 2012 – Report

Carcasses as vectors:

- April/May 2012 – Construct carcass holding system
- May/June 2012 – Euthanize fish and begin trial
- September 2012 – Conclude trial
- November 2012 – Process data
- December 2012 – Report

Measures of Progress

2.1 Rate of nonnative species newly detected in the Great Lakes ecosystem

Work supported by this template contributes to goals 1 and 5 of the Action Plan: Goal 1: The introduction of new invasive species to the Great Lakes basin ecosystem is eliminated, reflecting a “zero tolerance policy” toward invasives. Goal 5: An effective, efficient and environmentally sound program of integrated pest management for invasive species is developed and implemented, including program functions of containment, eradication, control and mitigation

Collaborative Arrangements

This project will be conducted in collaboration with the US Army Corps of Engineers as part of the ECALS project funded by GLRI.

Budget Information

Personnel \$ 82,800

Fringe Benefits	\$ 27,600
Travel	\$ 14,100
Equipment	\$ 65,900
Contracts	\$ 0
Indirect Costs	\$ 9,600
Total	\$ 200,000

Asian Carp Framework 2.5.6 - Use of Seismic Technology to Divert and Eradicate Asian Carp

Total Funding: \$500,000

Authority for work: USGS Organic Act 43 U.S.C. 31, the General Cooperation Authority 43 U.S.C. 36c, and the Water Resources Research Act of 1984 – 42 USC 10303 (h)(1)(D)

Description of Work

Methods now available to control nuisance and non-native, invasive fishes are inadequate. Some methods are expensive, labor intensive, and non-selective, or length specific. Proximity of Asian carp (bighead carp and silver carp) to the Great Lakes Basin highlights the need to make quickly available additional control methods to affect their behavior, thereby impeding their spread into the Great Lakes, or to remove Asian carp through direct mortality. Seismic technology has the potential to affect the behavior or eradicate nuisance and non-native invasive fishes through a range of age classes, making it a viable candidate for integrated suppression efforts.

FY 2011 Actions Undertaken

During FY 2011 a postdoctoral fish ecologist was hired, additional water guns were purchased, a seismic array was tested to determine behavioral modification in carp and lethality in threatened and endangered species. Research in FY 2011 determined the ability of pulse pressures emitted from water guns to repel carp using a static barrier followed by a trial to assess the ability of a mobile barrier to repel and divert carp. Tests were conducted in the CSSC and shipping locks.

FY 2012 Actions Proposed

Research in FY 2012 will refine the ability of pulse pressures emitted from water guns to repel carp using a stationary barrier in the CSSC. Mobile water gun barriers will also be further refined to divert, herd and capture carp in rivers. Additional studies will evaluate the efficacy of water guns to repel juvenile and larval Asian carp.

Milestones

- July 2012: Complete studies in the CSSC to refine parameters and logistics for the deployment of a water gun barrier that will repel Asian carp
- September 2012: Complete dose response and behavioral studies on small and juvenile carp.
- September 2012: Complete evaluation and refinement for capture and diversion studies of the mobile water gun barrier

Measures of Progress

2.1 Rate of nonnative species newly detected in the Great Lakes ecosystem

Develop and Demonstrate Innovative Control Technology – Promote the development and use of new control technologies, including biological control methods, which will significantly reduce the cost and/or increase the effectiveness of invasive species control measures.

Collaborative Arrangements

USACE, USFWS, ILDNR, USEPA

Budget Information

Personnel	\$ 159,150
Fringe Benefits	\$ 53,050
Travel	\$ 35,000
Equipment	\$ 64,000
Contracts	\$ 165,000
Indirect Costs	\$ 23,800
Total	\$ 500,000

Asian Carp Framework 2.5.17 - Chicago Area Waterway System Monitoring Network Evaluation

Total Funding: \$ 190,000

Authority for work: USGS Organic Act 43 U.S.C. 31, the General Cooperation Authority 43 U.S.C. 36c, and the Water Resources Research Act of 1984 – 42 USC 10303 (h)(1)(D)

Description of Work

The current status of flow monitoring stations on the Chicago Area Waterway System is insufficient for the evaluation of data from on-going sampling programs targeting Asian Carp detection in the CAWS or for the evaluation of proposed waterway separation scenarios. Hydraulic and water quality models of the CAWS are an important tool for data-based decision-making. Development and calibration of these models requires flow data throughout the CAWS. Phase I of this project will compile historical flow and water-quality data from the CAWS into a single database that will streamline model development and calibration. Phase II of this project will evaluate the historical database and the current network of gaging stations on the CAWS to identify the critical inputs and gaps in information. Phase III of the project will fill the data gaps through synoptic field measurements and possible new monitoring locations. These phases, at times, will be completed concurrently.

Milestones

- A single database for historical streamflow and water quality data has been established under the web-based Chicago Waterways Observatory (<http://il.water.usgs.gov/data/cwo>). Data continues to be added to the CWO database.
- Preliminary analysis of the CAWS monitoring network has identified gaps in flow and water-quality data.
- A synoptic survey of water temperatures through the entire 90 + miles of navigable waterways was conducted in September 2011 to provide modelers a snapshot picture of thermal loads and gradients within the CAWS.
- A side-looking acoustic Doppler current profiler was deployed in October 2011 on the Calumet Sag Channel near Sag Junction to collect stage, velocity and discharge data to quantify the distribution of flows between the Chicago Sanitary and Ship Canal and the Cal-Sag Junction (identified as a strategic waterway location for the development of hydraulic models of the CAWS).

Measures of Progress

2.3 Number multi-agency plans established, mock exercises to practice rapid responses carried out under those plans, and/or actual rapid response actions

The proposed physical separation within the CAWS poses several challenges for transportation, wastewater management and regional flood control. In order to address these issues, engineers and scientists will use hydraulic and water quality models of the waterway to evaluate the proposed separation. This project will compile a hydraulic and water-quality database for the CAWS with the goal to provide efficient model calibration and greater confidence in model results. Engineers and scientists will then be able to evaluate the feasibility of waterway separation based upon valid hydraulic and water-quality data and better mitigate the impacts on transportation, wastewater management, and regional flood control. The calibrated models can also be used for the planning of the multi-agency invasive species rapid response efforts within the CAWS. In addition, detailed hydraulic data within the waterway are required for the design and evaluation of new invasive species barrier technologies and the delivery of pesticides and other biological control agents.

Collaborative Arrangements

This project is a collaborative effort between USGS scientists and engineers and scientists from the Metropolitan Water Reclamation District of Greater Chicago, the U.S. Army-Corps of Engineers (USACE), and the University of Illinois-Department of Civil and Environmental Engineering. Some of this effort supports the USACE's Great Lakes/Mississippi River Interbasin Study project goals, and regular consultation with the hydrology and hydraulics lead for that project.

Budget Information

Personnel	\$ 105,375
Fringe Benefits	\$ 35,125
Travel	\$ 10,000
Equipment	\$ 5,000
Contracts	\$ 25,000

Cooperative Agreements	\$ 0
Indirect Costs	\$ 9,500
Total	\$ 190,000

Asian Carp Framework 2.5.19 - Seismic Monitoring for Asian Carp Water Gun Deployment

Total Funding: \$213,700

Authority for work: USGS Organic Act 43 U.S.C. 31, the General Cooperation Authority 43 U.S.C. 36c, and the Water Resources Research Act of 1984 – 42 USC 10303 (h)(1)(D)

Description of Work

The potential impact of the deployment of a water gun(s) used to modify the behavior of Asian carp within the CSSC and the rest of the CAWS on the structures (such as the controlling works, electric barrier, etc.) and canal walls is unknown. Seismic data collection is planned to complete an assessment of the distribution of seismic energy when the water gun(s) is used within the CSSC, and other parts of the CAWS near O'Brien Lock and Dam, and compare it to energy created by barge traffic and industry background seismic sources. The water gun(s) have been proposed to be used in the maintenance cycle on the electric barrier to help remove fish from the area between Electric Barriers 2A and 2B.

FY 2010 Actions Undertaken: In September 2010, the water gun was deployed in old sand and gravel pits connected to the Illinois River, and was monitored with surface geophysical instrumentation for seismic signals generated on land. The monitoring showed ground responses to the water guns, with the magnitudes approximate in signal strength to a car driving on the dirt road nearby or people walking nearing the geophones. However, the conditions at this location with unconsolidated sands and gravels would be considerably different than the dominantly bedrock conditions present in the CSSC, and more of the seismic energy from the water gun would be expected to transfer to the bedrock, as well as reflected back into the CSSC. Also, concerns on sheet piles and other structures were not assessed.

FY 2011 Actions Undertaken: Seismic data collection was completed in the CSSC test site above the Fish Barrier. Seismic Data was collected for watergun shots, industry background, and background barge signals using geophones and hydrophones located on water, land, and at the canal wall. Preliminary data indicates that for the area above the Barrier on land consisting of bedrock, the watergun produces approximately two orders of magnitude more energy than passing barge traffic.

FY 2012 Actions Proposed: Seismic data collection will be collected at the O'Brien Lock and Dam area. Data will be collected with the watergun downstream of the lock adjacent to the sheetpile walls, as well as background barge data.

Data from the 2011 CSSC and O'Brien testing will be compiled and interpreted by Dr. Carpenter (Northern Illinois University) and the USGS.

Milestones

- December 2011 - Installation of three boreholes for O'Brien Lock and Dam work (completed)
- March 2012 - Processing and review of CSSC data
- April 2012 - Acquisition of seismic data with water gun deployment at the O'Brien Lock and Dam.
- Summer 2012 - Processing and review of O'Brien data
- September 2012 - Data Series Report for Seismic Data of September 2011 CSSC work first draft

Measures of Progress

2.3 Number multi-agency plans established, mock exercises to practice rapid responses carried out under those plans, and/or actual rapid response actions

The Great Lakes Restoration Initiative Action Plan is directly influenced by the seismic data collection work as it pertains to Focus Area 2 (Non-native Species):

Measure 1 (rate of non-native species detected in the Great Lakes) will be greatly enhanced by confirmation of viability of watergun implementation.

Measure 2 (acres of land managed for invasive species):-- successful confirmation and implementation of the watergun will reduce acres needed to be monitored.

Collaborative Arrangements

This project is in collaboration with Northern Illinois University. Dr. Carpenter is involved with collecting and analyzing the seismic data. Illinois DNR and USACE are also involved with the project logistics.

Budget Information

Personnel	\$ 114,271
Fringe Benefits	\$ 38,090
Travel	\$ 7,516
Equipment	\$ 2,139
Contracts	\$ 41,000
Indirect Costs	\$ 10,684
Total Costs	\$ 213,700

Asian Carp Framework 2.5.21 - Other Science Contributing to Asian Carp Efforts

Funding Amount: \$100,000

Authority for work: USGS Organic Act 43 U.S.C. 31, the General Cooperation Authority 43 U.S.C. 36c, and the Water Resources Research Act of 1984 – 42 USC 10303 (h)(1)(D)

Description of Work

USGS has been conducting research on Asian carps since they first became abundant in Missouri, Illinois, and Mississippi rivers. Initially, this research focused on distribution, habitat

use, life history, conditions conducive to spawning, and age determination. As more was learned, additional research into the ecological impacts of bighead and silver carps on river ecology began, and continues today. Information gleaned from these studies has directly or indirectly benefited many Framework projects, from monitoring and surveillance to risk assessment and control. This is research that supports Framework efforts and is important for achieving Framework goals.

Funding will support ongoing research on control technologies and ecological studies of riverine populations (including analysis of bighead carp diet to ascertain level of consumption of larval fishes).

Milestones

Research on control technologies and ecological studies of riverine studies are conducted in a prompt and efficient manner to support the Asian Carp Framework actions.

Measures of Progress

2.3 Number multi-agency plans established, mock exercises to practice rapid responses carried out under those plans, and/or actual rapid response actions

Develop and Demonstrate Innovative Control Technology – Promote the development and use of new control technologies, including biological control methods, which will significantly reduce the cost and/or increase the effectiveness of invasive species control measures.

Collaborative Arrangements

USACE, USFWS, ILDNR, USEPA

Budget Information

Personnel	\$ 71,250
Fringe Benefits	\$ 23,750
Travel	\$ 0
Equipment	\$ 0
Contracts	\$ 0
Indirect Costs	\$ 5,000
Total	\$ 100,000

Asian Carp Framework 2.6.3 - eDNA Calibration and Increased Efficiency

Funding Amount: \$225,000

Authority for work: USGS Organic Act 43 U.S.C. 31, the General Cooperation Authority 43 U.S.C. 36c, and the Water Resources Research Act of 1984 – 42 USC 10303 (h)(1)(D)

Description of Work

eDNA is a genetic surveillance tool that indicates presence of bighead and silver carp DNA in the environment. It was used as a monitoring tool for the ACRCC's MRRWG April 2011

MRRP. USACE, in partnership with USFWS, USGS, and USEPA, is developing a proposal to conduct an eDNA calibration study that will help provide context to a positive eDNA result. Variables investigated will include detection limits and decay rates; improvement in current field sampling techniques may result from investigation of optimal sampling methods.

Additionally, by determining the number of genotypes expressed in the collected eDNA samples, we can determine the minimum population of bighead or silver carp needed to yield a positive eDNA sample from the field. eDNA calibration is critical to enhance eDNA sampling for monitoring, and to render current sampling designs and protocols more effective. Interim products will become available to improve management decisions and interpretations of eDNA results.

USGS will be procuring fish and examining the shedding of eDNA fish to gain a better understanding of eDNA detection limits and decay rates.

Milestones

- Report detailing protocol for rapid extraction and analysis of eDNA samples
- Report describing a series of descriptive relationships between Asian carp biomass and eDNA detection using PCR

Measures of Progress

2.1 Rate of nonnative species newly detected in the Great Lakes ecosystem

Rate of Asian carp detection by eDNA will be improved

Collaborative Arrangements

- Lead agencies USACE, USGS, USFWS
- Collaboration USEPA

Budget Information

Personnel	\$ 52,312
Fringe Benefits	\$ 17,438
Travel	\$ 16,000
Equipment	\$ 8,000
Contracts	\$ 120,000
Indirect Costs	\$ 11,250
Total	\$ 225,000

Asian Carp Framework 2.6.5 - eDNA Genetic Marker Development

Total funding: \$50,000

Authority for work: USGS Organic Act 43 U.S.C. 31, the General Cooperation Authority 43 U.S.C. 36c, and the Water Resources Research Act of 1984 – 42 USC 10303 (h)(1)(D)

Description of Work

One of the goals of the eDNA calibration study is to determine if the population of Asian carp (AC) can be estimated using eDNA samples. One potential method is to use multiple alleles or single nucleotide polymorphisms (SNPs). The U.S. Geological Survey Upper Midwest Environmental Sciences Center (UMESC) will assist with collecting, processing and analyzing DNA samples from multiple populations of AC. This project is a continuation of ACRCC Framework 2.6.5 and complements ACRCC Framework 2.6.3. UMESC will assist in the collection of tissues for DNA analysis from AC from various populations and help extract DNA from those tissues and prepare it for sequencing. Once the DNA is sequenced, UMESC will work with researchers from the Army Corps of Engineers to compare nucleotide sequences among the populations. If multiple alleles are detected, then the alleles will be analyzed to determine if they can be used as an individual marker. If multiple markers are identified, then the use of these markers on eDNA samples will be assessed to determine if they can estimate the size of the population of AC.

Milestones

- July 2012 – Genetic analysis of AC from different populations
- August 2012 – Complete analysis for multiple alleles
- September 2012 – Verify markers on environmental samples

Measures of Progress

2.1 Rate of nonnative species newly detected in the Great Lakes ecosystem

Rate of Asian carp detection by eDNA will be improved

Collaborative Arrangements

This project will be in collaboration with the US Army Corps of Engineers as part of the ECALS project funded by GLRI.

Budget Information

Personnel	\$ 21,450
Fringe Benefits	\$ 7,150
Travel	\$ 6,000
Equipment	\$ 13,000
Contracts	\$ 0
Indirect Costs	\$ 2,400
Total	\$ 50,000

Nearshore Health and Nonpoint Source Pollution

Template 73 - Avian Botulism in Distressed Great Lakes Environments.

Total funding: \$569,453

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Botulism intoxication is caused by ingestion of neurotoxins produced by the bacterium *Clostridium botulinum*. Periodic outbreaks of type E botulism have resulted in die-offs of fish and fish-eating birds in the Great Lakes since at least the 1960s, but outbreaks have become more common and widespread since 1999. Botulism has been responsible for over 100,000 bird deaths on the Great Lakes since 1999, and extensive bird mortality in northern Lake Michigan near Sleeping Bear Dunes National Lakeshore (SLBE; over 4150 birds in 2007) received widespread press attention and caused great public concern. The actual sites of toxin exposure for birds remain unknown.

Spores of *C. botulinum* are naturally widely distributed in the environment, but toxin production occurs only when suitable environmental conditions allow spore germination and cell growth, and this may be related to local soil and water conditions. The physical and ecological factors that are associated with toxin production, waterbird exposure, and botulism outbreaks are poorly understood in the Great Lakes, as in other environments. Invasive species, particularly dreissenid mussels *Dreissena spp.* and round gobies *Neogobius melanostomus*, have been implicated in the recent increased occurrence of botulism mortality in Great Lakes fish and birds, but this has not been proven. Dreissenid mussels may enhance nearshore algal growth, and decomposing algae may help create the anoxic conditions required for *C. botulinum* germination.

We hypothesize that recent increases in the incidence of type E avian botulism outbreaks in the Great Lakes may be associated with the presence of large amounts of decomposing sloughed *Cladophora*. We propose to determine the presence or absence of *C. botulinum* and type E botulinum toxin in sediments. In FY 2012, targeted sampling sites will be chosen in northern Lake Michigan near SLBE to represent sites that support varying amounts of sloughed *Cladophora* at a range of depths throughout the season. We further propose to use population surveys to assess waterbird distribution, with emphasis on species historically impacted by type E botulism (e.g., common loon *Gavia immer*), to examine the spatial relationships between bird distribution and carcass detection of confirmed botulism mortalities, and to analyze the relation between botulism in birds and environmental conditions at locations where toxin exposure is likely to occur.

Because of the ongoing nature of this work, it is non-severable.

Milestones

FY 2012: We will complete analysis of the distribution of the gene for botulinum toxin in lake sediments related to physicochemical variables for 2010-2011. Preliminary results suggest that the occurrence of the gene for the toxin is related to temperature. We plan to publish these results in 2012.

FY 2010 – 2012: USGS scientists have conducted several low-level, systematic aerial surveys over selected areas of northern Lake Michigan to document the fall distribution of waterbirds at-risk to type-E botulism. Results from these surveys are being used to inform site-specific efforts to assess the degree to which physical and ecological factors contribute to the occurrence of botulinum toxin in aquatic food webs.

FY 2010 – 2012: The fall movements and foraging patterns of a sentinel waterbird species at risk to botulism intoxication, the common loon, were documented by tracking migration movements coupled with foraging depth profiles of individual loons equipped with archival geolocator tags and/or satellite transmitters. Thirty-one loons were marked with both satellite transmitters and geolocator tags, and an additional 86 loons were marked with geolocator tags only. Forty-four geolocator tags have been recovered from marked loons and many of these have provided dive profile data for loons while foraging in Lake Michigan. Movements of radiomarked loons are posted on the UMESC public website and updated weekly (http://www.umesc.usgs.gov/terrestrial/migratory_birds/loons/migrations.html). An understanding of feeding patterns and exposure routes of sentinel waterbird species historically at risk to botulism die-offs, such as the common loon, is central to assessing pathways of botulism exposure through aquatic food chains in the Great Lakes and identification of physical and biological linkages that drive botulism outbreaks.

Measures of Progress

3.4 Annual number of days U.S. Great Lakes beaches are closed or posted due to nuisance algae.
2.3 Number multi-agency plans established, mock exercises to practice rapid responses carried out under those plans, and/or actual rapid response actions.

The ultimate goal of this project is to develop management actions to reduce fish and bird mortality during botulism outbreaks. If, as we suspect, recent increases in botulism outbreaks are due to the presence of large amounts of decomposing algae, the presence of which is due to the effects of dreissenid mussels, then this will represent a reduction in the negative effects of dreissenids on fish and bird populations in the Great Lakes.

Applicable Goals, Objectives, and Measures from Great Lakes Action Plan:

Supports Focus Area 2: Invasive Species

Goal 5: An effective, efficient and environmentally sound program of integrated pest management for invasive species is developed and implemented, including program functions of containment, eradication, control, and mitigation.

Supports Focus Area 3: Nearshore Health and Nonpoint Source Pollution

Goal 3: The presence of bacteria, viruses, pathogens, nuisance growths of plants or animals, objectionable taste or odors, or other risks to human health are reduced to levels in which

water quality standards are met and beneficial uses attained to protect human use and enjoyment of the nearshore areas.

Collaboration Arrangements

National Park Service, U. S. Fish and Wildlife Service, Wisconsin Department of Natural Resources, Minnesota Department of Natural Resources, University of Wisconsin – Madison, University of Wisconsin – Milwaukee, BioSentinel Pharmaceuticals, Common Coast Research and Conservation, The Nature Conservancy, Northeastern Wisconsin Audubon Society, Michigan Tech Research Institute, Northern Michigan University.

Budget Information

Personnel	\$ 162,750
Fringe Benefits	\$ 54,250
Travel	\$ 54,500
Equipment and Supplies	\$ 93,500
Contracts	\$ 177,000
Cooperative Agreements	\$ 0
Indirect Costs	\$ 27,543
Total	\$ 569,543

Template 76 - Forecast/Nowcast Great Lakes Nutrient and Sediment Loadings

Total funding: \$506,261

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The USGS nutrient tributary monitoring network follows the National Monitoring Network for Coastal Waters design. Scientists collect real-time, near-real-time, and synoptic flow and water-quality data (sediment and nutrients) from tributaries to the Great Lakes. The data provide baseline information to assess effectiveness of restoration and land management activities. Site-specific regression equations are being developed to relate selected laboratory-analyzed analyte concentrations in the discrete samples to measurements recorded by the water-quality monitors. This will enable near-continuous estimates of analytes and allow a reduction in laboratory samples, reducing costs while preserving temporal density of data. This work supports Great Lakes Lakewide Area Management Plans and Remedial Action Plans.

A methodology for providing uncertainty estimates on regression models of field measurements of water quality vs. hourly surrogate estimates of those water-quality parameters has been developed using Kalman filtering procedures. These filters will be used to estimate magnitudes and uncertainties of suspended-sediment concentrations and flows, which will help compute the expected magnitudes and uncertainties of loads of selected water-quality constituents at each site in the future.

Because of the ongoing nature of this work, it is non-severable.

Milestones

At 30 tributary monitoring sites, automated samplers, water-quality multi-sensor probes, and gage house and stage equipment have been deployed. Water samples collected at the 30 tributary monitoring sites include suspended sediment; nutrients (incl. nitrogen, nitrite, nitrite + nitrate, total nitrogen, ortho-phosphorus (SRP), and total phosphorus); chloride, and bacteria. One sample per storm event is analyzed for major ions. At each site, monthly base flow samples are being collected, plus up to eight storms, with 6 samples submitted per storm (48 environmental samples per site/per year). In-situ water-quality sensors deployed at each site measure and record turbidity, temperature, conductivity, dissolved oxygen and pH every 15 minutes.

Measures of Progress

3.1 Five year average annual loadings of soluble reactive phosphorus from tributaries draining targeted watersheds.

Work funded by this template will directly contribute to measure 1 of the Nearshore and Non-Point Source Focus Area which is: "Five year average annual loadings of soluble reactive phosphorus¹⁸ from tributaries draining targeted watersheds." Monitoring will provide a direct measure of soluble reactive phosphorus concentration from the 30 tributaries, which include the targeted watersheds of the Fox, Saginaw, Maumee, St. Louis, and Genesee Rivers. From this measure and the associated streamflow data, average annual loadings can be computed.

Collaborative Arrangements

Streamgage costs at all sites are supported by a variety of cooperative agreements.

Budget Information

Personnel	\$ 176,961
Fringe Benefits	\$ 58,987
Travel	\$ 30,000 (includes vehicle mileage)
Equipment	\$ 40,000 (supplies)
Contracts	\$ 0
Cooperative Agreements	\$ 0
Indirect Costs	\$ 25,313
Laboratory	\$ 175,000 (USGS-NWQL and Kentucky USGS sediment lab)
Total	\$ 506,261

Template 77 - Enhance Recreational Water-Quality Decision Making at Great Lake Beaches

Total funding: \$464,072

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

USGS will improve and refine existing beach predictive models, rapid methods, and the identification of sources of fecal contamination, pathogens, and viruses at beaches in the Great Lakes in order to improve beach managers decision-making.

This funding would be used enhance existing efforts to advance the science of monitoring and assessing recreational water quality to provide beach managers with reliable, science-based information to make well-informed beach closure decisions to protect public health focusing on: Identifying and evaluating new or rapid methods to improve monitoring of bacteria at beaches.

- Identifying physical and biological processes that influence the occurrence and abundance of key bacteria and pathogens that pose risks to recreational users of beaches and nearshore waters.
- Enhancing existing models and expanding models to additional beaches to improve forecasts of water quality and support more timely and effective public health warnings, advisories, and beach closures.
- Improving communication of monitoring and scientific information and developing tools to enhance response of beach managers to changing beach and water quality.

Because of the ongoing nature of this work, it is non-severable.

Milestones

- Implement and provide the training rapid method use at 4 beaches.
- Continue the analysis and interpretation of the over 350 pathogen samples collected in FY2011.
- Continue the collaboration with USEPA to integrate new statistical techniques into the next version of Virtual Beach as well as distribute data compilation and web service tools to allow beach modelers to access spatially processed meteorological, hydrodynamic, and other environmental data.
- Continue the development of predictive models at 8 beaches in Ohio, 6 beaches in Pennsylvania, and 10 beaches in Wisconsin for implementation of nowcast modeling in FY 2013.

Measures of Progress

3.2 Percentage of beaches meeting bacteria standards 95% or more of beach days.

3.4 Annual number of days U.S. Great Lakes beaches are closed or posted due to nuisance algae.

This project directly supports the achievement of Measures of Progress 2 and 4 of Focus Area 3: Nearshore Health and Nonpoint Source Pollution as Defined In the Great Lakes Restoration Initiative Action Plan.

Collaborative Arrangements

This work is being coordinated closely with USEPA and NOAA efforts through the Great Lakes Beach Health Interagency Coordination Team. In addition a number of individual state and local

agencies are directly involved with efforts on the over 50 beaches that are part of the coordinated effort to date.

Budget Information

Personnel	\$ 284,858
Fringe Benefits	\$ 71,214
Travel	\$ 45,000
Equipment	\$ 40,000
Contracts	\$ 0
Cooperative Agreements	\$ 0
Indirect Costs	\$ 23,000
Total	\$ 464,072

Template 366 - Evaluation of Phosphorus Reduction in Targeted Geographic Watersheds – Fox River, Wisconsin

Total funding: \$100,000

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The Great Lakes Restoration Initiative (GLRI) was established to accelerate ecosystem restoration in the Great Lakes by confronting the most serious threats to the region, such as nonpoint source pollution, toxic sediments, and invasive species. Three Priority Watersheds have been targeted by the Regional Working Group's Phosphorus Reduction Work Group (Fox/Green Bay, Saginaw, and Maumee) and are characterized by having a high density of agricultural land use and have ecosystem impairments that have been clearly identified.

Within these Priority Watersheds, monitoring will be conducted at the sub-watershed, edge-of-field, and/or subsurface-tile scale. The edge-of-field and subsurface-tile monitoring stations will be targeted to those areas within each watershed that will be directly affected by the conservation efforts. These sites will allow for a rapid assessment of conservation implementation as the water quality from those locations are immediately affected by land-use and management changes and represent the major pathways for non-point pollution to enter the stream. Relationships between the smaller to sub-watershed scale will help develop an understanding on how conservation efforts may impact the watershed as a whole.

Because of the ongoing nature of this work, it is non-severable.

Milestones

The sub-watershed and one of the two edge-of-field stations have been selected and instrumented. Automated samplers, gage houses, and stage and power equipment has been placed at the monitoring locations. Water samples collected at both the sites will be analyzed for suspended sediment, chloride, nitrate+nitrite, ammonium, total kjedlahl nitrogen (unfiltered),

reactive phosphorus, and total phosphorus (unfiltered). At the sub-watershed streamgage, monthly base flow samples will be collected, plus up to 6 storms at 10 samples submitted per storm. At the installed edge-of-field location there will be up to 10 storms sampled at 1 time-based composite sample analyzed per storm. The second edge-of field site will be selected and installed by May 2012. There will be up to 3 storm samples at 1 time-based composite sample analyzed per storm.

Measures of Progress

3.1 Five year average annual loadings of soluble reactive phosphorus from tributaries draining targeted watersheds.

Monitoring at the priority watershed scale will provide a direct measure of the effects of USDA conservation practice implementations on reducing erosion and nutrients by targeting those areas affected by the conservation practice. This study will also provide data to verify the five year average annual loading targets of soluble reactive phosphorus as described in the Great Lakes Action Plan.

Collaborative Arrangements

Site selection, maintenance, and on-farm information are being collected in cooperation with the local Brown County U.S.D.A. Natural Resource Conservation Service, Brown County Land and Water Conservation Department, local crop consultants, and private landowners/producers.

Budget Information

Personnel	\$ 15,422
Fringe Benefits	\$ 5,142
Travel	\$ 500
Equipment	\$ 62,000
Contracts (incl. lab)	\$ 11,936
Cooperative Agreements	\$ 0
Indirect Costs	\$ 5,000
Total	\$ 100,000

Template 367 - Evaluation of Phosphorus Reduction in Targeted Geographic Watersheds – Maumee River, Ohio

Total funding: \$100,000

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The Great Lakes Restoration Initiative (GLRI) was established to accelerate ecosystem restoration in the Great Lakes by confronting the most serious threats to the region, such as nonpoint source pollution, toxic sediments, and invasive species. Three Priority Watersheds have

been targeted by the Regional Working Group's Phosphorus Reduction Work Group (Fox/Green Bay, Saginaw, and Maumee) and are characterized by having a high density of agricultural land use and have ecosystem impairments that have been clearly identified.

Within these Priority Watersheds, monitoring will be conducted at the sub-watershed, edge-of-field, and/or subsurface-tile scale. The edge-of-field and subsurface-tile monitoring stations will be targeted to those areas within each watershed that will be directly affected by the conservation efforts. These sites will allow for a rapid assessment of conservation implementation as the water quality from those locations are immediately affected by land-use and management changes and represent the major pathways for non-point pollution to enter the stream. Relationships between the smaller to sub-watershed scale will help develop an understanding on how conservation efforts may impact the watershed as a whole.

Because of the ongoing nature of this work, it is non-severable.

Milestones

Determination of the sub-watershed and two edge-of-field sites will begin in FY 2012. Automated samplers, gage houses, and stage and power equipment will be placed at the monitoring locations by June 2012. Water samples will be collected at all the sites and will be analyzed for suspended sediment, chloride, nitrate+nitrite, ammonium, total kjedlahl nitrogen (unfiltered), reactive phosphorus, and total phosphorus (unfiltered). At the sub-watershed streamgage, monthly base flow samples will be collected, plus up to 2 storms at 10 samples submitted per storm. At the two edge-of-field locations it is estimated to monitor 2 storm events with 1 time-based composite sample analyzed for each event.

Measures of Progress

3.1 Five year average annual loadings of soluble reactive phosphorus from tributaries draining targeted watersheds.

Monitoring at the priority watershed scale will provide a direct measure of the effects of USDA conservation practice implementations on reducing erosion and nutrients by targeting those areas affected by the conservation practice. This study will also provide data to verify the five year average annual loading targets of soluble reactive phosphorus as described in the Great Lakes Action Plan.

Collaborative Arrangements

Site selection, maintenance, and on-farm information are being collected in cooperation with the local U.S.D.A. Natural Resource Conservation Service, Ohio Department of Natural Resources, U.S.D.A. Agricultural Research Service, Ohio State University, Heidelberg University, local crop consultants, and private landowners/producers.

Budget Information

Personnel	\$ 18,858
Fringe Benefits	\$ 6,286
Travel	\$ 3,000
Equipment	\$ 62,000

Contracts (incl lab)	\$ 4,856
Cooperative Agreements	\$ 0
Indirect Costs	\$ 5,000
Total	\$ 100,000

Template 368 - Evaluation of Phosphorus Reduction in Targeted Geographic Watersheds – Saginaw River, Michigan

Total funding: \$100,000

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The Great Lakes Restoration Initiative (GLRI) was established to accelerate ecosystem restoration in the Great Lakes by confronting the most serious threats to the region, such as nonpoint source pollution, toxic sediments, and invasive species. Three Priority Watersheds have been targeted by the Regional Working Group's Phosphorus Reduction Work Group (Fox/Green Bay, Saginaw, and Maumee) and are characterized by having a high density of agricultural land use and have ecosystem impairments that have been clearly identified.

Within these Priority Watersheds, monitoring will be conducted at the sub-watershed, edge-of-field, and/or subsurface-tile scale. The edge-of-field and subsurface-tile monitoring stations will be targeted to those areas within each watershed that will be directly affected by the conservation efforts. These sites will allow for a rapid assessment of conservation implementation as the water quality from those locations are immediately affected by land-use and management changes and represent the major pathways for non-point pollution to enter the stream. Relationships between the smaller to sub-watershed scale will help develop an understanding on how conservation efforts may impact the watershed as a whole.

Because of the ongoing nature of this work, it is non-severable.

Milestones

Determination of the sub-watershed and two edge-of-field/subsurface tile sites will begin in FY 2012. Automated samplers, gage houses, and stage and power equipment will be placed at the monitoring locations by June 2012. Water samples will be collected at all the sites and will be analyzed for suspended sediment, chloride, nitrate+nitrite, ammonium, total kjedahl nitrogen (unfiltered), reactive phosphorus, and total phosphorus (unfiltered). At the sub-watershed streamgage, monthly base flow samples will be collected, plus up to 2 storms at 10 samples submitted per storm. At the two edge-of-field/subsurface tile locations it is estimated to monitor 2 storm events with 1 time-based composite sample analyzed for each event.

Measures of Progress

3.1 Five year average annual loadings of soluble reactive phosphorus from tributaries draining targeted watersheds.

Monitoring at the priority watershed scale will provide a direct measure of the effects of USDA conservation practice implementations on reducing erosion and nutrients by targeting those areas affected by the conservation practice. This study will also provide data to verify the five year average annual loading targets of soluble reactive phosphorus as described in the Great Lakes Action Plan.

Collaborative Arrangements

Site selection, maintenance, and on-farm information are being collected in cooperation with the local U.S.D.A. Natural Resource Conservation Service, local crop consultants, and private landowners/producers.

Budget Information

Personnel	\$ 18,858
Fringe Benefits	\$ 6,286
Travel	\$ 3,000
Equipment	\$ 62,000
Contracts (incl. lab)	\$ 4,856
Cooperative Agreements	\$ 0
Indirect Costs	\$ 5,000
Total	\$ 100,000

Habitat and Wildlife Protection and Restoration

Template 70 - Fish Habitat Enhancement Strategies for the Detroit River

Total funding: \$675,014

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The purpose of this work is to develop science-based adaptive management strategies and management tools to restore high fishery productivity in the Detroit River and to provide relevant up-to-date biological information to assist development of delisting criteria for fish habitat loss Beneficial Use Impairments. The work funded by this template aids in our understanding of the natural processes occurring in the system in order to best apply efforts aimed at restoring and enhancing native fish habitat and populations in the Huron-Erie Corridor through multi-agency/organization bi-national partnerships. Identifying, assessing, and prioritizing sites of natural fish spawning and nursery activity will provide essential information required for future fish spawning habitat construction and fish nursery habitat restoration designed to address Beneficial Use Impairments in the Detroit River Area of Concern (AOC) and help define what constitutes adequate remediation in the AOC.

In FY 2012, laboratory sample processing and field collections will be conducted to continue development of decision support systems for managers using geospatial, hydrodynamic and ecological process models to determine the optimal areas for restoring fish spawning and nursery habitats. Managers will use the information provided to determine the proper course of action required for protecting, enhancing, or restoring existing native spawning habitat or creating new fish spawning (e.g. Manny 2006; Roseman et al. 2011) and/or nursery habitat in areas that meet criteria for fish life history stages (preferred substrate for spawning and flow connectivity to downstream nursery areas). Field collections in FY 2012 will focus on fish spawning and nursery habitat assessments in the Detroit River to provide new data for the model efforts described above, provide pre-construction assessment information for other GLRI funded projects (e.g. Blue Heron Lagoon, Belle Isle wetland and South fishing pier, U.S. Steel shoreline restoration), and provide post-construction information at the Belle Isle and Fighting Island spawning reefs.

Integrating geospatial and hydrodynamic models with ecological fisheries data will estimate natural habitat attributes (geomorphology, flow regimes, depths, substrate characteristics, and bank slope) that provide baseline parameters for fish habitat remediation activities. Ecological process models will couple physical and biological fish habitat parameters and further identify potential priority sites where productive fish spawning habitats are linked with suitable nursery habitats. Data collected will be applied to models estimating larval fish production and contributions of HEC stocks to Lake Erie populations (e.g. Brodник et al. In prep.; Zhao et al. 2009; GLFC-funded project to S. Ludsin, Ohio State Univ.; molecular genetics, C. Stepien, Univ. Toledo). In addition, ecological models will provide information regarding the effects of high nutrient loads and harmful algal blooms on fish survival in nursery grounds. These applied

science efforts will provide new knowledge about the linkages between fish spawning and nursery habitat which is used to direct restoration activities (e.g. replace lost spawning habitat; manage recovering populations; Roseman et al. 2012). Ultimately, the degree of success in restoring fish populations is measured by the percent of young fish produced in enhanced habitats that are recruited into reproductive adult fish populations.

Because of the ongoing nature of this work, it is non-severable.

Milestones

- Acquire and make available comprehensive physical and biological information necessary to characterize and/or restore existing native fish spawning and nursery habitat in the HEC where reproductive habitat is a limiting factor in the restoration of native fish populations. Databases and information were collected and assembled on the spawning and nursery habitat use by native sport, commercial, prey fish, and state and federally listed species of concern so that scientists and resource managers can interpret relationships and interactions between physical habitat features (e.g. substrate, flow, water temperature) and biological life history of fishes; December 2011.
- Completed two years of intensive field sampling to assess the extent of fish use of existing spawning and nursery habitats. Over 8,000 samples of fish eggs and larvae were collected at sites throughout the Detroit River and across a multitude of habitat types. Laboratory and statistical analyses of collected samples (e.g. identification of larvae, diet assessments, micro-elemental assessment of stock lineage, genetic analyses, multivariate analyses, and bio-physical modeling) are ongoing in FY 2012 and FY 2013.
- This project supported and collaborated in the development of a bio-physical model to predict suitable sites for additional spawning habitat restoration in the HEC (Bennion and Manny, In review). This model coupled life history requirements of important lithophilic spawning fishes (e.g. walleye, lake whitefish, lake sturgeon), with hydrologic attributes of the rivers to show where river depth and flow meet the requirements for fish spawning. Model results demonstrate the importance of island heads and main channel fringe habitats as potential spawning habitats. This project (Template 70) also contributed data and samples to projects assessing the genetic connectivity and divergence of walleye and yellow perch in the HEC, development and validation of a bio-physical model of walleye movement and habitat use in western Lake Erie, and stock identification of Lake Erie yellow perch using otoliths micro-elemental signatures (cited above).

Measures of progress

4.3 Number of species delisted due to recovery.

4.4 Percent of recovery actions implemented for priority listed species.

4.5 Percent of populations of native aquatic non-threatened and endangered species self-sustaining in the wild.

4.9 Number of habitat-related Beneficial Use Impairments removed from the 27 U.S. Areas of Concern so impaired.

This project is promoting implementation of the GLRI Great Lakes Action Plan as well as areas of increased emphasis by GLNPO for FY2012 and 2013.

Great Lakes Action Plan

Focus Area 4: Habitat and Wildlife Protection and Restoration.

Goal 1: Protection and restoration of Great Lakes aquatic and terrestrial habitats, including physical, chemical, and biological processes and ecosystem functions, maintain or improve the conditions of native fish and wildlife.

Goal 3: Sound decision making is facilitated by accessible, site specific and landscape-scale baseline status and trend information about fish and wildlife resources and their habitats.

Measure 6. Will provide information for protecting wetlands that provide important nursery grounds for Great Lakes fishes.

Measure 9. Will aid in removal of BUIs in the Detroit River.

Collaborative Arrangements

Data collected during 2010 and 2011 as part of GLRI Project Template 70, as well as data collected by GLSC and HEC partners in previous years, were used to inform the development of the predictive habitat model (Bennion and Manny, In review) that is the basis for GLRI Project Template 379: Remediation of Fish and Wildlife Habitat in the St. Clair River AOC. While GLRI Project Template 70 will focus on laboratory analyses, model development, and field collections in the Detroit River, and the emphasis for Project Template 379 is the St. Clair River, many of the same scientists will continue to be involved in both projects during FY 2012 and beyond.

USGS and Huron-Erie Corridor Initiative partners have developed scientific strategies, methods, and tools and, learning from two previous habitat construction projects, are adaptively improving techniques to address the BUI loss of fish spawning habitat in the Huron-Erie Corridor. Partners include FWS, EPA, Michigan Department of Natural Resources, Ohio Department of Natural Resources, Tribal representation, Non-governmental Agencies, industry, and both provincial and Federal agencies from Canada. This part of the project is building on an ongoing EPA-funded project to meet AOC delisting goals by developing a “blueprint” for fish habitat restoration in the HEC.

GLSC scientists collaborated with researchers from The Ohio State University, Ohio Division of Wildlife, and Ontario Ministry of Natural Resources to develop and validate a bio-physical model for western Lake Erie larval walleye. Continued assessments of fish spawning and larval production in the Detroit River during FY 12 and FY 2013 are needed to facilitate collaborative population and habitat modeling efforts (Lake Erie Bio-physical models [S. Ludsin et al., Ohio State Univ.]; larval production [C. Mayer and M. DuFour, Univ. Toledo], post construction spawning habitat use; genetics [C. Stepien, Univ. Toledo]; lake sturgeon ecology and larval production [N. Auer, MI Technological Univ.])

GLSC scientists collaborated with researchers from University of Toledo to assess the genetic connectivity and divergence of walleye and yellow perch collected in the Detroit River (Haponski and Stepien, In review; Sullivan and Stepien, In review). Results of these analyses show a need for larger sample sizes to better represent Detroit River spawning stocks.

GLSC scientists collaborated with scientists from The Ohio State University and University of Windsor to assess the stock identification of yellow perch in western Lake Erie using otolith

microchemistry (Brodnik et al. in prep.). Additional samples of water and larval fishes will be collected from the Detroit River during FY 12 and FY 2013 to augment this study.

GLSC scientists collaborated with researchers from the Great Lakes Fishery Commission, Michigan DNR, and Ohio Division of Wildlife to develop and implement an acoustic telemetry array in the HEC to assess movements of walleye and lake sturgeon (<http://www.glfc.org/telemetry/>).

GLSC scientists conducted field assessments of fish use of aquatic habitats near GLRI-funded restoration projects in the Detroit River at Belle Isle Blue Heron Lagoon, Belle Isle South fishing pier and nursery habitat, and U.S. Steel shoreline enhancement, and fish spawning reef construction at the Middle Channel of the St. Clair River (MI Sea Grant).

GLSC scientists at Ann Arbor and Sandusky are collaborating with scientists from Ontario MNR and Ohio DNR to explore the long-term interjurisdictional bottom trawl data series to assess the contributions of fishes from the HEC and Lake Huron to Lake Erie populations. Trawl data from western Lake Erie will be compared with historic (Hatcher et al. 1991) and contemporary larval fish data collected from the HEC to assess relationships in abundances and distributions within the data.

This project was coordinated with work being done by the U.S. Geological Survey under a separate Interagency Agreement for \$100,000 that is related the Coordinated Science and Monitoring Initiative (CSMI) work for the Connecting Channels. This Agreement was signed on December 31, 2009.

Budget Information

Personnel	\$ 142,729
Fringe benefits	\$ 47,577
Travel	\$ 68,540
Equipment	\$ 49,054
Contracts	\$ 333,360
Indirect costs	\$ 33,754
Total	\$ 675,014

Template 71 - New Strategies for Restoring Coastal Wetland Function, Maumee River Area of Concern

Total funding: \$295,319

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

USGS will focus on restoring natural hydrologic processes in diked coastal wetlands adjacent to Great Lakes waters to improve wetland functions like phosphorus retention and restoration of

habitats for fish and wildlife. Sustainable approaches are being developed in the Maumee River Area of Concern (AOC) to restore the hydrology and other processes that drive coastal wetland functions and increase ecosystem resiliency. Results will be evaluated within an adaptive management framework and be immediately applicable to similar sites in the Saginaw River/Bay AOC and throughout the Great Lakes basin.

The purposes of the project are to:

- hydrologically reconnect a diked wetland to Lake Erie to restore coastal wetland function and native species habitats,
- implement a short- and long-term monitoring program to characterize response of biotic and abiotic ecosystem elements, especially those relating to Beneficial Use Impairments after restoration actions, and
- communicate project results to researchers, managers, policy makers, and the general public to ensure that outcomes of the project can guide future management and restoration efforts throughout the Great Lakes basin.

Since the connection to the wetland was restored, the abundance and diversity of fish using the wetland habitats has exploded. Northern pike and other recreationally and commercially valued species are again using the 40ha wetland for reproduction and feeding. Preliminary water-quality data indicate that the water exiting the wetland back into the Maumee River AOC had significantly less phosphorus and other nutrients than the incoming water, which has very positive implications for the water quality BUI for the Maumee River AOC. Additional samples taken through FY 2012 will characterize the spatial and temporal patterns of fish use, nutrient retention, and other important wetland processes.

Because of the ongoing nature of this work, it is non-severable.

Milestones

Water quality and biota sampling will continue in FY 2012 to characterize spatial and temporal patterns within restored wetland habitats and share that information with regional managers and partner agencies leading similar restoration projects.

1. Completed intensive data collection and monitoring for first season before reconnection of wetland habitats, November 2010
2. USGS, FWS, and Ducks Unlimited worked together to design, build, and open a water-control structure on April 2011, thus reconnecting 40 ha of wetland to Lake Erie
3. Intensive sampling of fish, birds, plants, benthic invertebrates and physical conditions on the Ottawa National Wildlife Refuge characterized ecosystem response during the first full growing season after the management action, December 2011
4. Intensive sampling will commence to quantify ecosystem changes during the second growing season in the restored wetland, April 2012
5. Water quality, fish assemblages, mussel use, and other AOC Beneficial Use Impairment-related data will be analyzed and communicated to resource managers and policy makers; September 2012
6. Fact sheets and presentations about the project will be developed for educational purposes at Ottawa National Wildlife Refuge and at other venues, September 2012

Measures of Progress

4.2 Number of fish passage barriers removed or bypassed.

4.6 Number of acres of wetlands and wetland-associated uplands protected, restored and enhanced

4.8 Percent of U.S. coastal Great Lakes wetlands assessed.

4.9 Number of habitat-related Beneficial Use Impairments removed from the 27 U.S. Areas Of Concern so impaired.

1.2 Area of Concern Beneficial Use Impairments removed

This project is promoting implementation of the GLRI Great Lakes Action Plan as well as areas of increased emphasis by GLNPO for FY 2012 and FY 2013.

Relevance to GLRI Action Plan and other priorities

Focus Area 1: Toxic Substances and Areas of Concern

This project is focused on the USFWS Ottawa National Wildlife Refuge located in the heart of the Maumee River Area of Concern (Long-Term Goal 1). Outputs and outcomes of the project are restoring coastal wetland habitats and providing data that support the removal of beneficial use impairments in the AOC (one of the objectives of this Focus Area). The project also is providing guidance to other habitat restoration projects located near the Saginaw River AOC (Shiawassee National Wildlife Refuge).

Focus Area 4: Habitat and Wildlife Protection and Restoration

This project involves restoration of Great Lakes aquatic habitats through the restoration of wetland ecosystem functions and improvement of conditions for native fish and wildlife (Long-Term Goal 1). The project also supports Long-term Goal 2 by restoring access of fish species to previously isolated habitats and conserving important fish and wildlife populations (i.e., northern pike, Lake Erie prey fish, native mussels). The intensive data collections associated with this project supports Long-Term Goal 3 by providing status and trend information to resource managers, especially how they respond to restoration actions. Goals 4 and 5 also are supported because the work is in line with the priorities of the Lake Erie LaMP and is very sensitive to and compatible with fish and wildlife and their habitats. Finally, the project includes many of the Principal Actions identified in the GLRI Action Plan; 1) *Improving Aquatic Ecosystem Resiliency* through restoring natural hydrological processes, 2) *Enhance Wetland Habitats* through restoration of natural hydrological regimes, improving water quality, and restoring ecosystem integrity, 3) *Identify, Inventory, and Track Progress on Great Lakes Habitats, Including Coastal Wetlands Restoration* through our multi-year intensive data collection strategy, and 4) *Restore Habitat Functioning in Areas of Concern* by removing impairments that limit ecosystem functioning.

Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships

This project supports many of the Long-Term Goals identified in the Action Plan through the efforts to communicate results to the public, managers, and decision makers through personal discussions, presentations, fact sheets, web pages, and other forms.

Lakewide Management Plans

Similar to the AOC beneficial use impairments, this project will collect data on fish, plant, and wildlife assemblages, phosphorus concentrations, and other water quality parameters that will contribute to the delisting process associated with the beneficial use impairments identified by IJC in the Lake Erie LaMP. Specifically, the project should address the following BUIs: Degraded Fish and Wildlife Populations, Degradation of Benthos, Eutrophication or Undesirable Algae, Recreational Water Quality Impairment, and Loss of Fish and Wildlife Habitat.

Other GLRI Projects

GLRI 70 – Fish Habitat Enhancement Strategies for the Huron-Erie Corridor

- The study site is located within the Huron-Erie Corridor, and linkages between connecting channel habitats and restored coastal wetlands are being explored.

GLRI 80 – Birds as Indicators of Contaminant Exposure in the Great Lakes

- Cooperation between projects led to the Ottawa NWR being selected as a study site for GLRI 80.

GLRI 79 – Mercury Cycling and Bioaccumulation in the Great Lakes

- Discussions with Dave Krabbenhoft regarding the methylation process and coastal wetland wetting/drying patterns may lead to coordinated sampling efforts if new funds are found.

GLRI 67/588 – Forecasting Potential *Phragmites* Coastal Invasion Corridors

- Field sampling occurred at the Ottawa NWR, including the sharing of detailed vegetation mapping data. Extensive stands of *Phragmites* on the refuge helped tune the GLRI 67/588 models.

The intense long-term data collection involved in this study directly relates to the delisting of BUIs in the Maumee River AOC (specifically collecting quantitative and repeated phosphorus, fish and wildlife population, and habitat data to evaluate progress toward delisting four BUIs: *Degraded Fish and Wildlife Population*, *Eutrophication or Undesirable Algae*, *Recreational Water Quality Impairment*, and *Loss of Fish and Wildlife Habitat*) and is already providing technical guidance to restoration efforts in the Maumee River and North Maumee Bay of Lake Erie (e.g., a \$2.5M NOAA GLRI award to The Nature Conservancy to restore over 735 acres of coastal wetland habitat at the Erie Marsh Preserve), the Maumee River AOC (e.g., a \$1.3M NOAA AOC Habitat Restoration Fund award to The Nature Conservancy to build fish-passage structures and restore 512 acres of coastal wetland habitat in the FWS Ottawa National Wildlife Refuge), the Saginaw River watershed (e.g., a \$1.5M National Fish and Wildlife Foundation award to Ducks Unlimited and USFWS to restore 940 acres of agricultural land in the Shiawassee National Wildlife Refuge to coastal wetlands), and several other projects along the Michigan and Ohio coasts of Lake Erie.

The water-quality sampling being conducted in the Maumee River Priority Watershed to continue documentation and analysis of significant total phosphorus and other nutrients reductions in waters flowing from restored coastal wetland habitats provide a baseline for other sites within the Maumee River AOC, western basin of Lake Erie, and the Shiawassee NWR and Saginaw River to help understand and document progress toward the delisting of the *Eutrophication or Undesirable Algae* BUI.

Work in FY 2012 will evaluate the impact that *Phragmites*, common carp, and other exotic and invasive species have on the restoration of ecological functions and explore how restoration projects involving Integrated Pest Management based invasive species control efforts (e.g., install carp exclusion grates only during periods when carp spawn) could increase ecosystem resiliency against invasion.

Collaborative Arrangements

Investigators are in contact with many other organizations (USFWS Ottawa National Wildlife Refuge, US FWS Shiawassee National Wildlife Refuge, The Nature Conservancy Michigan, Ducks Unlimited, Michigan Department Natural Resources, Ohio Department Natural Resources, Ducks Unlimited Canada, University of Manitoba) that are implementing or planning to implement similar wetland restoration projects throughout the western Lake Erie landscape (Maumee River AOC), Saginaw Bay (Saginaw River/Bay AOC), and Lake Manitoba.

Budget Information

Personnel	\$ 33,666
Fringe benefits	\$ 8,417
Travel	\$ 18,200
Equipment	\$ 17,500
Contracts	\$ 202,770
Indirect costs	\$ 14,766
Total	\$ 295,319

Template 72 - Native Fish Restoration

Total funding: \$322,319

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Using principles of applied science, USGS scientists are identifying techniques and strategies that will provide the highest probability of success for native species restoration in Lake Ontario for Atlantic salmon and deepwater coregonids (bloaters). USGS is uniquely positioned to carry out the full array of restoration strategies, including fish propagation and post stocking evaluation for Atlantic salmon. Because of the complexities associated with the extirpation or decline of native fish species in the Great Lakes there is no single remedy suitable for the restoration of all species. Recent increases in the abundance of coregonids in the upper Great Lakes are coincident with dramatic declines in alewife populations. Unfortunately, although alewife populations in Lake Ontario are declining, there are no deepwater coregonids remaining in the lake to enable natural recovery. Consequently, the restoration of deepwater coregonids, as well as extirpated Atlantic salmon, must at least initially rely on hatchery-reared fish.

The GLRI funding thus far has been used to complete the construction of an isolation facility that

allows researchers to bring both adults and eggs from the wild and hold, spawn, and rear them, and release appropriate life stages for restoration efforts. Continued project funding enables purchase and rearing of Atlantic salmon and deepwater coregonid eggs for rearing and release in adaptive management studies and potential for native fish restoration to include sturgeon and perhaps advance practices to include Lake Erie.

Milestones

- Approximately 65,000 fall fingerling Atlantic salmon were released in Lake Ontario tributaries in September 2011. Another 8,000 fall fingerling salmon were released in St. Lawrence River tributaries in October in partnership with the St. Regis Mohawk Tribe.
- The UV building came on-line in November.
- The State of Vermont could only provide 50,000 (received December 2011) of the 125,000 Atlantic salmon eggs we requested. We will be purchasing the remaining 75,000 eggs from the State of Maine.
- Collaborative efforts between the NYSDEC and Tunison resulted in the collection of approximately 70 adult lake herring in Lake Ontario in December. As a result Tunison is now rearing 60,000 plus lake herring eggs in the UV building. Tunison is anticipating receiving bloater eggs in January.

Measures of Progress

4.3 Number of species delisted due to recovery.

4.4 Percent of recovery actions implemented for priority listed species.

4.5 Percent of populations of native aquatic non-threatened and endangered species self-sustaining in the wild.

This project is promoting implementation of the GLRI Great Lakes Action Plan by providing information on adaptive management strategies for restoring native fishes in the Great Lakes:

Focus Area 4: Habitat and Wildlife Protection and Restoration.

Goal 1: Protection and restoration of Great Lakes aquatic and terrestrial habitats, including physical, chemical, and biological processes and ecosystem functions, maintain or improve the conditions of native fish and wildlife.

Goal 2: Critical management activities protect and conserve important fish and wildlife populations.

Goal 3: Sound decision making is facilitated by accessible, site specific and landscape-scale baseline status and trend information about fish and wildlife resources and their habitats.

This work supports those objectives and measures related to propagation of native species (measures 3, 4, and 5).

EPA Focus Areas on Invasives and AOCs: Restoration of native fishes is best implemented in areas with reduced invasive species (such as alewives) and demonstrates the BUI in former AOC.

Collaborative Arrangements

Funding from this template supports restoration of native Atlantic salmon and bloater in Lake Ontario by raising fish, reintroducing them and conducting survival assessments to evaluate success of applied science native fish restoration strategies. USGS scientists are working closely with NY Department of Environmental Conservation, US EPA, tribal, and Canadian agencies (OMNR) to ensure that the scientifically-based techniques and strategies used provide the highest probability of rehabilitation success and avoid potential fish diseases. This project will phase in restoration of lake herring in Lake Erie using similar methods.

Budget Information

Personnel	\$ 36,744
Fringe benefits	\$ 9,186
Travel	\$ 5,000
Equipment	\$ 37,418
Contracts	\$ 217,855
Indirect costs	\$ 16,116
Total	\$ 322,319

Template 74 - Changes in Nutrient Transfer within Great Lakes Food Webs: Implications for Fish

Total funding: \$264,099

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

This study follows EPA's year of intensive sampling around the Great Lakes. GLRI work complements and expands upon EPA and other partner entities. On each lake, USGS samples the food web along from a nearshore (18 m) to offshore (110 m) gradient. On each lake, the research aims to determine whether changes in lower trophic levels are driving declines in prey fish biomass, which could have negative consequences for restoration of lake trout and the success of important recreational and commercial fisheries. Further, by deploying similar sampling designs across all the Great Lakes, we can make food web comparisons across the Great Lakes, where we have gradients of invasive species biomass and lake productivity.

Lake Michigan: The year of intensive sampling in Lake Michigan took place in FY 2010. Accomplishments include the completion of Lake Michigan Ecosystem Model that is being used by fishery managers to explore different stocking scenarios to support restoration of native lake trout.

Lake Superior: Successful collection of biological data at multiple trophic levels (phytoplankton, zooplankton, and fish) in Lakes Michigan (FY 2010) and Superior (FY 2011) will facilitate comparisons of energy flow between systems with differing biomass of invasive species and different levels of overall productivity. Future analysis (that will include additional lakes in

coming years) may reveal the inefficiency of systems with high biomass of invasives.

Lake Huron: Funding from FY 2011 will be used for Lake Huron sampling in 2012 and allow comparison of results from the 2007 Year of Intensive Sampling in Lake Huron. During that study, an invasive zooplankter (*Bythotrephes*) was found to be the culprit in large reduction of zooplankton biomass.

Lake Ontario: Funding in FY 2012 will be applied in 2013 to Lake Ontario's intensive sampling. The advance funding would enable USGS to improve cross agencies collaboration and prepare coordinated field work designs for an efficient and effective sampling strategy. It allows us and our partners to leverage additional participation and funding in FY 2013 efforts.

Milestones

Lake Ontario: Sampling would target seasonal energy flow through all levels the food chain from primary production through production of top predators. Planning will incorporate the lessons learned from Lakes Michigan and Superior. The drastic changes in lower trophic level production that occurred in the upper lakes seem to have also occurred in Lake Ontario. An understanding of these events has been identified by partners across the lake as a priority area for investigation, and will be a key area of focus in our coordinated science monitoring efforts.

Measures of Progress

4.4 Percent of recovery actions implemented for priority listed species.

2.3 Number multi-agency plans established, mock exercises to practice rapid responses carried out under those plans, and/or actual rapid response actions

Understanding the effects of invasive invertebrates and fish on the flow of energy through the food chain is essential in aiding managers with appropriate information for fish restoration efforts. This project is promoting implementation of the GLRI Great Lakes Action Plan as well as areas of increased emphasis by GLNPO for FY 2012 and FY 2013.

By providing a framework for understanding the effects of changing conditions (nutrients, invasive species), pest management control options, and management concerns (fish restoration), this work supports focus areas 2 and 4 Great Lakes Action Plan.

Focus Area 2: Invasive Species

Goal 5: An effective, efficient and environmentally sound program of integrated pest management for invasive species is developed and implemented, including program function of containment, eradication, control and mitigation.

Measure 3. Will provide models to determine effectiveness of control plans.

Focus Area 4: Habitat and Wildlife Protection and Restoration.

Goal 1: Protection and restoration of Great Lakes aquatic and terrestrial habitats, including physical, chemical, and biological processes and ecosystem functions, maintain or improve the conditions of native fish and wildlife.

Goal 3: Sound decision making is facilitated by accessible, site specific and landscape-scale baseline status and trend information about fish and wildlife resources and their habitats.

Measure 4. Will provide information for recovery action plans.

Collaborative Arrangements

This study is a multi-agency endeavor that includes state, federal, provincial, and tribal entities involved in the lake. These include:

US EPA, US Fish and Wildlife Service, Illinois Department of Natural Resources, Indiana Department of Natural Resources, Michigan Department of Natural Resources, Minnesota Department of Natural Resources, New York State Department of Environmental Conservation, Ohio Department of Natural Resources, Pennsylvania Fish and Boat Commission, Wisconsin Department of Natural Resources, Chippewa-Ottawa Resource Authority, Great Lakes Indian Fish & Wildlife Commission, Ontario Ministry of Natural Resources, Department of Fisheries and Oceans Canada, and Environment Canada.

Budget Information

Personnel	\$ 119,115
Fringe benefits	\$ 29,779
Travel	\$ 30,000
Equipment & Supplies	\$ 42,000
Contracts	\$ 30,000
Indirect costs	\$ 13,205
Total	\$ 264,099

Template 379 - St. Clair River Area of Concern Fish Habitat Restoration Projects

Total funding: \$2,350,000

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Loss of fish and wildlife habitat is Beneficial Use Impairment 14 in the St. Clair and Detroit River Areas of Concern. Since 2003, research monitoring and fish spawning habitat construction by the US Geological Survey, in collaboration with the Michigan Sea Grant and 15 other partners, has remediated loss of fish and wildlife habitat in the Detroit River, at Belle Isle (0.3 acres--see www.huron-erie.org and Manny 2006) and at Fighting Island (0.81 acres, see: <http://www.fws.gov/midwest/sturgeon/documents/4-19-08-PressRelease.pdf> and Roseman et al. 2011) at a combined cost of \$780,000 from US and Canadian sources. A third fish habitat remediation project by USGS and Michigan Sea Grant, funded by the NOAA Great Lakes Habitat Restoration Program, is in progress now for construction of 1.25 acres of fish spawning habitat in the Middle Channel of the St. Clair River in March 2012, at a cost of \$500,000. These three fish spawning habitat remediation projects have increased spawning success of more than 12 native fish species in the Detroit River, including the State- and Provincially-threatened lake sturgeon, and the commercially-valuable lake whitefish, and walleye that support fisheries in

Lake Erie, worth over \$2 Billion per year. The purpose and objectives of this research are compatible with the Strategic Vision for the U.S. Geological Survey in the Great Lakes-St. Lawrence Region (USGS 2000) and the National Fish Habitat Action Plan (www.fishhabitat.org).

In 2011, with \$100,000 of funding from the USEPA, the USGS modeled where water depth and water flow velocity are suitable for spawning by desirable native fish species, such as lake sturgeon, lake whitefish, and walleye, in the St. Clair and Detroit Rivers (see Bennion and Manny 2011a). This research revealed 9 sites in the St. Clair River and 9 sites in the Detroit River where water depth and flow are theoretically suitable for spawning by these three and other native fish species in these two rivers. Based on selected environmental criteria, their model assumed that these are the most suitable sites for successful spawning by native fish in the St. Clair River. In 2012 and 2013, with FY 2012 funding from the GLRI, the USGS Great Lakes Science Center proposes to conduct comprehensive physical and biological assessments of the substrates at the 9 potential St. Clair River spawning sites predicted by the geospatial model, compare and contrast spawning habitat quality at the 9 sites, and select two to three sites in Michigan waters where all requirements for spawning by native fishes are met, except for the presence of adequate amounts of rock rubble (> 30 cm of rubble thickness). At those two to three sites, with about 60 percent of the requested funds, we will construct two to three fish spawning habitat projects, 1.0-1.5 acres in size, in the St. Clair River to further remediate past losses of fish spawning habitat in the St. Clair River AOC. The remaining FY2012 GLRI funds will be used for pre-construction site assessment and selection for spawning habitat construction and post-construction monitoring of fish egg deposition, larval fish production and geospatial modeling of fish spawning and nursery habitat connectivity at and downstream of the selected sites for habitat construction in the St. Clair AOC, and public outreach by Michigan Sea Grant to share the results of this remediation work with the Great Lakes community. Our pre-construction 2012 assessments will result in the name, location and size of each project and how many can be accomplished by the end of FY 2013. Our scientific assessments will measure the increase in fish production at the sites, as a result of this fish spawning habitat construction project. Concurrently, geospatial modeling will be conducted by D. Bennion and B. Manny to assess connectivity of St. Clair River fish spawning habitat site to fish nursery habitat in the St. Clair and Detroit Rivers, the St. Clair Delta, and Lake St. Clair.

The St. Clair River AOC Habitat Public Advisory Committee has identified the proposed actions as necessary to meet the Michigan Department of Environmental Quality delisting criteria for the removal of the loss of fish and wildlife habitat beneficial use impairment in the St. Clair River AOC.

Estimated Project Costs: Two years of pre- and post-construction assessment of habitat conditions and fish egg and larval production: about \$970,000; Fish spawning habitat construction: about \$1,380,000. Total (gross) project cost is \$2,350,000.

Milestones

1. Since 2003, the USGS and its partners have acquired and made available comprehensive physical and biological information needed to restore native fish spawning habitat in the Huron-Erie Corridor between Lakes Huron and Erie (see www.huron-erie.org and Bennion

and Manny 2011a), where reproductive habitat is a limiting factor in the restoration of native fish populations, as a result of shipping channel construction years ago (Bennion and Manny 2011b). Databases and information were collected and assembled on the spawning and nursery habitat used by native sport, commercial, prey fish, and state and federally listed species of concern so that scientists and resource managers can interpret relationships and interactions between physical habitat features (e.g. river bottom substrates, water depth, water temperature, and water flow rates) and the biological life history of valued fishes. This information will also be used to develop a scientific larval fish drift study to occur in FY 2013 that will test the physical linkages and processes involved between fish spawning habitat (constructed and existing) and known fish nursery habitats downstream.

2. Since 2009, the USGS and its partners completed two years of intensive field sampling to assess the extent of fish use of existing spawning and nursery habitats in the St. Clair River. This information will be integrated into ongoing modeling efforts and development of a fish larvae drift study planned for FY 2012 and FY 2013.
3. Related projects at the Great Lakes Science Center (GLSC) supported and collaborated in the development of a bio-physical model to predict suitable sites for additional spawning habitat restoration in the Huron-Erie Corridor (HEC). This model coupled life history requirements of important benthic, lithophilic, spawning fishes (e.g. walleye, lake whitefish, lake sturgeon), with hydrologic attributes of the rivers to show where river depth and flow meet the requirements for spawning by these fish species. Model results demonstrate the importance of island heads and deep, main channels as potential fish spawning habitats in the St. Clair and Detroit Rivers. GLSC projects also contributed data and samples to projects that are assessing the genetic connectivity and divergence of lake sturgeon, walleye and yellow perch in the HEC, development and validation of a bio-physical model of walleye movement and habitat use in western Lake Erie, and stock identification of Lake Erie yellow perch, using micro-elemental signatures of otoliths.

Measures of Progress

4.4 Percent of recovery actions implemented for priority listed species.

4.5 Percent of populations of native aquatic non-threatened and endangered species self-sustaining in the wild.

4.6 Number of acres of wetlands and wetland-associated uplands protected, restored and enhanced.

4.9 Number of habitat-related Beneficial Use Impairments removed from the 27 U.S. Areas of Concern so impaired.

This project is promoting implementation of the GLRI Great Lakes Action Plan, as well as areas of increased emphasis by GLNPO for FY 2012 and FY 2013.

For example:

Great Lakes Action Plan

Focus Area 4: Habitat and Wildlife Protection and Restoration

Goal 1: Protection and restoration of Great Lakes aquatic and terrestrial habitats, including physical, chemical, and biological processes and ecosystem functions, and maintain or improve the conditions of native fish and wildlife.

Goal 3: Sound decision making is facilitated by accessible, site specific and landscape-scale baseline status and trend information about fish and wildlife resources and their habitats.

Measure 6. This project will provide information for protecting wetlands that provide important nursery grounds for Great Lakes fishes along shorelines of islands and main channels in the Detroit and St. Clair Rivers.

Measure 9. This project will aid in removal of BUIs and AOC designations for the St. Clair River and provide information about the abundance and distribution of invasive species in the Huron-Erie Corridor (HEC).

Collaborative Arrangements

USGS and Huron-Erie Corridor Initiative partners have developed scientific strategies, methods, and tools and, learning from two previous habitat construction projects, and are adaptively improving techniques to address BUI 14, loss of fish spawning habitat in the Huron-Erie Corridor (St. Clair and Detroit Rivers and Lake St. Clair). Partners include EPA, Michigan Sea Grant, USFWS, Michigan Department of Natural Resources, Detroit River International Wildlife Refuge, Ohio Department of Natural Resources, Tribal and First Nations representation, Non-governmental Agencies, industry, and both provincial and Federal agencies in Canada.

This proposed project is building on an ongoing EPA-funded project to meet AOC delisting goals by developing a “blueprint” for fish habitat restoration in the HEC.

HEC scientists collaborated with researchers from The Ohio State University, Ohio Division of Wildlife, and Ontario Ministry of Natural Resources to develop and validate a bio-physical model for larval walleye in western Lake Erie.

HEC scientists collaborated with researchers from University of Toledo to assess the genetic connectivity and divergence of walleye and yellow perch collected in the HEC.

HEC scientists collaborated with scientists from the Ohio State University and the University of Windsor to assess the stock identification of yellow perch in western Lake Erie using otolith microchemistry.

HEC scientists collaborated with researchers from the Great Lakes Fishery Commission, Michigan DNR, and Ohio Division of Wildlife to develop and implement an acoustic telemetry array in the HEC to assess movements of walleye and lake sturgeon.

HEC scientists conducted field assessments of fish use of aquatic habitats near GLRI-funded restoration projects in the Detroit River at Belle Isle-Blue Heron Lagoon, U.S. Steel shoreline, and fish spawning reefs to be constructed in the Middle Channel of the St. Clair River in 2012.

Budget Information

Personnel	\$ 480,263
Fringe benefits	\$ 66,550
Travel	\$ 203,516
Equipment	\$ 127,908
Contracts	\$ 1,354,263
Indirect	\$ 117,500
Total	\$ 2,350,000

Accountability, Education, Monitoring, Evaluation, Communication and Partnerships

Template 81 - Watershed Modeling for Stream Ecosystem Management

Total funding: \$421,884

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Project provides unified information across the Great Lakes Basin for ecosystem restoration, assessment, and management by incorporating models that relate changes in landscape and hydrologic variables and stresses to changes in ecosystem function. The project relies upon regionally consistent hydrologic, biologic, and geospatial data to generate regionally consistent estimates, models, and analysis.

USGS is the Circular A-16 theme lead for hydrographic spatial data. As such USGS has responsibility to coordinate with other federal agencies, states, and other entities the development and stewardship of the National Hydrography Dataset (NHD). USGS also has developed in partnership with EPA the NHDPlus, it has a memorandum of understanding with The Nature Conservancy to study environmental flows and impacts of hydrologic alterations on ecology. USGS has been a lead agency in the development of techniques and methods to estimate streamflow characteristics in gaged and ungaged watersheds and in developing, applying, and coordinating research in ecology and hydroecology.

Products from this research will include a consistent hydrologic dataset of the US Great Lakes Basin built on the 1:100,000 NHDplus and attributed with landscape and aquatic ecologic variables. Empirical models developed for fish distribution, temperature, and streamflow will be developed. A hierarchical lotic habitat classification framework and fish-based lotic habitat classification will be built on the hydrologic dataset. Field sampling and experimental campaigns aimed at testing and improving the lotic classification schemes will be designed. The sampling design will be implemented by coordinating with existing field-based sampling teams and efforts through Federal and State agencies and Universities.

Milestones

March 2012 – draft estimated monthly flows for all stream segments in the 1:100,000 NHDPlus dataset for water years 1950-2009 will be completed and sent to state USGS Water Science Centers for review and input.

October 2012 – draft stream classifications built on estimated streamflows, fish distribution modeling, and temperature modeling will be developed and shared with partner agencies for review and input.

October 2012 – Status of data availability for estimation of streamflow depletion by wells for the Great Lakes Basin and assessment of techniques to estimate streamflow depletion will be completed.

March 2013 – Final estimates of monthly flows for all stream segments in the 1:100,000 NHDPlus dataset for water years 1950-2009 and description of processes used to develop these flows will be documented and available.

Measures of Progress

5.2 Number of priority LaMP projects that are completed.

4.7 Number of acres of coastal, upland, and island habitats protected, restored and enhanced.

Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships. Two goals from this focus area benefit from this research. The ungaged flow estimates provide key information for assessing tributary streamflow within the Basin to meet:

1. By 2014, a statistically valid and comprehensive assessment, using a probability-based design, of Great Lakes water resources, will be established. The system will integrate shipboard monitoring, remote sensing, automated sampling, and other monitoring or observing efforts. By 2016, the system will be in place for all of the Great Lakes and capable of providing a scientifically justifiable assessment of Great Lakes water resources.
2. By 2014, timely data and information will be provided to decision makers at multiple scales within a framework of established baselines, targets, indicators of progress, and monitoring.

Collaborative Arrangements

State officials are being contacted about the streamflow estimates and stream classification work to coordinate this work with state ecosystem efforts.

Budget Information

Personnel	\$ 300,916
Fringe benefits	\$ 84,874
Travel	\$ 15,000
Equipment & Supplies	\$ 0
Contracts	\$ 0
Indirect costs	\$ 21,094
Total	\$ 421,884

Template 82 - Characterizing Habitat and Food Web Structures across Great Lakes Estuaries

Total funding: \$210,942

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Work under this project during FY 2012 will build directly on work completed in FY 2010-2011, which included both intensive and extensive sampling of over 30 rivermouths across all Great Lakes. Based on the broad-scale knowledge gained in our initial two years of work, we will focus our efforts during FY 2012 on addressing four specific questions or objectives important to the management and restoration of Great Lakes rivermouths:

1. *Do rivermouths listed as AOCs function differently than non-AOC rivermouths?* Areas of Concern (AOCs) are designated due to legacy contamination or habitat alteration or to other anthropogenic impacts that have presumably disrupted the provisioning of ecosystem services from these systems. However, lack of general understanding of rivermouth ecosystems means that appropriate reference conditions and reasonable restoration and conservation goals for these rivermouth AOCs are lacking. Rivermouths along the western shore of Lake Michigan make an ideal suite of study sites for determining whether AOC systems are functionally different than non-AOC systems. This work will focus on indicators of disturbance in rivermouth and nearshore food webs (using fatty acid profiles of benthic invertebrates), on removal of nutrients within the rivermouth (between riverine delivery and transport to the nearshore), and on sources of nutrients for rivermouth and nearshore food webs (using stable isotopes of C and N in benthic invertebrates). For greater efficiency and cost-effectiveness, this work will be integrated with ongoing work by USGS researchers from the Wisconsin Water Science Center.
2. *Are riverine nutrients incorporated into nearshore and deepwater food webs?* The abundance of invasive dreissenid mussels in deepwater and nearshore habitats of the Great Lakes (especially Lakes Huron and Michigan) have resulted in low nutrient availability to the base of these important foodwebs throughout open Lake habitats. Rivermouths, rich in watershed-derived nutrients, appear comparatively productive and important for region-wide fishery production. However, the importance of these watershed-derived nutrients has not been fully evaluated quantitatively. We will sample consumers (fish and basal consumers) from the Thunder Bay River longitudinally from river to deepwater habitats in order to quantify the role of watershed nutrients (C and N) to the composition of nearshore and deepwater food webs. Work during 2012 will focus on intensive sampling of the Thunder Bay River. This work is being coordinated with a multi-agency initiative (also funded via GLRI) occurring during a year of intensive sampling for Lake Huron that is focused on examining mechanisms underlying apparent food web collapse in that lake. The rivermouth project combined with LaMP support funds administered by the USGS Michigan Water Science Center will address key questions about nutrient inputs into Thunder Bay, the primary study area.
3. *Do rivermouths associated with watersheds having high phosphorus loads or concentrations significantly affect the delivery of nutrients to the nearshore?* Transport of nutrients from watersheds to the nearshore zone of the Great Lakes is often modeled based on data collected at riverine gaging stations that are up-river from any Lake-induced seiche influences. However, located between river gages and the nearshore zone are rivermouth habitats that include areas with long water residence times and consequently high deposition of particulate matter. When determining phosphorus (P) loading to the nearshore, these depositional areas

may be particularly important, as P is often associated with particulate material. We will sample nutrient dynamics (N and P) moving down-river from a tributary to Lake Huron through the rivermouth zone and into the nearshore zone. We will again focus this work on the Thunder Bay River, as we will already be operating in this system for the purposes of question B (above) and in connection with ongoing work by other USGS researchers and other federal agencies (e.g., NOAA).

4. *Processing, analysis and interpretation of data collected during FY 2011.* Our 2011 field season involved collection of thousands of samples, many of which involve lengthy laboratory analysis before yielding interpretable information (e.g., lipid analysis may take 3-6 months). Analysis and interpretation of these data is an essential ongoing activity within this project.

Milestones

- We will determine differences in benthic invertebrate health and food source at Lake Michigan rivermouths identified as Areas of Concern compared to nearby undisturbed rivermouths.
- We will measure the influence of phosphorus on metrics of fisheries and foodweb health and food source using quantitative analysis of tissue fatty acids and stable isotopes (carbon and nitrogen) in Thunder Bay River, MI (Lake Huron).
- We will estimate the contribution of river- and watershed-derived food sources on nearshore and deepwater fisheries (Thunder Bay River bay, Lake Huron).
- Sampling during FY 2012 will represent the fourth river that has been sampled intensively, and the project will be tied more closely to multi-agency efforts designed to examine mechanisms underlying food web changes. Data and techniques from the rivermouth project will provide information that is vital to that effort, but would have been otherwise unavailable.

Measures of Progress

5.2 Number of priority LaMP projects that are completed.

1.2 Area of Concern Beneficial Use Impairments removed

3.1 Five year average annual loadings of soluble reactive phosphorus from tributaries draining targeted watersheds

4.8 Percent of U.S. coastal Great Lakes wetlands assessed.

4.9 Number of habitat-related Beneficial Use Impairments removed from the 27 U.S. Areas of Concern so impaired.

Information generated from spatially intensive sampling in FY 2012 will help better understand what will be required to restore impacted rivermouths (e.g., AOCs) and to remove existing BUIs, specifically including (3) degradation of fish populations, (5) animal reproduction problems, (8) eutrophication, (11) degradation of aesthetics, (12) added costs to agriculture, and (14) loss of fish habitat. This information will also contribute directly to specific Measures of Progress for each of the following Focus Areas and goals:

Focus Area 1: Toxic Substances and Areas of Concern:

Goal 5. Our analyses of benthic invertebrate health and food source in rivermouth AOCs and similar non-AOC rivermouths will provide metrics of impairment and baseline information for restoration targets and benchmarks.

Focus Area 3: Nearshore Health and Nonpoint Source Pollution: Our analyses of the condition and health of fisheries and supporting food webs in the phosphorus-impacted Thunder Bay River and nearshore areas will provide critically important information for Goals 1, 2, 5, and 6:

Goal 1. Determination of health (lipid quality and quantity) and food source quality (carbon and nitrogen isotopes) in rivermouth, nearshore and deepwater benthic communities.

Goal 2. Measurement of land-use and land-cover impacts on nearshore and rivermouth foodweb health focused on target benthic invertebrates and fish species.

Goal 5. Determine patterns of land-use and land-cover and their effects on nutrient incorporation by river, rivermouth and nearshore consumers.

Goal 6. Our field measurements will be unique, of high quality, timely, and provide relevant information about nearshore areas useful for future management, protection, and restoration of these dynamic ecosystems.

Focus Area 4: Habitat and Wildlife Protection and Restoration: Our analyses of the condition and health of fisheries and supporting food webs in the phosphorus-impacted Thunder Bay River and nearshore areas will provide critically important information for the following goals:

Goal 1. Provides new insight into the ecosystem functions and biological processes critical to maintain and restore conditions of native fish (e.g., determine patterns of watershed and lake-shed control of lipid-rich food production and consumption; hydraulic controls of high quality food supplies delivered to rivermouth ecosystems from lakes).

Goal 3. Provides site-specific and landscape-scale baseline status about biological and ecosystem processes supporting fisheries and their habitats (e.g., characterizes land use effects [phosphorus enrichment] on N, C incorporation by river, rivermouth, nearshore and deepwater benthos and fish).

Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships: Our monitoring in embayment and nearshore areas will provide critically important information for the following goals:

Goal 1. A cooperative monitoring and observing system provides a comprehensive assessment of the Great lakes ecosystem. To help meet:

Objective 5: a refined suite of science-based indicators for development of a comprehensive assessment of Great lakes ecosystem health will be identified.

Objective 9: a comprehensive assessment of Great Lakes water resources that include monitoring and observing efforts. And

Objective 10: provide timely data and information to decision makers.

Sampling in 2012, combined with results of 2010-2011 activities, will result in development of a rivermouth model that will improve understanding of how flows and nutrients are assimilated and processed as rivers enter the Great Lakes. This has direct application for understanding the fate of contaminants in Areas of Concern, guiding restoration efforts and targets so that outcomes are more predictable, and understanding the role of rivermouths as habitat.

Collaborative Arrangements

Dr. Michael Wiley, University of Michigan School of Natural Resources and Environment, collaborated with project scientists during FY 2011 and played a key role in development of the The Great Lakes Rivermouth Collaboratory. He will continue to advise us on various aspects of habitat modeling and will work closely with us throughout FY 2012.

Budget Information

Personnel	\$ 94,794
Fringe benefits	\$ 23,698
Travel	\$ 33,715
Equipment & Supplies	\$ 6,485
Contracts	\$ 42,205
Indirect costs	\$ 10,045
Total	\$ 210,942

Template 84 - USGS GLRI Database

Total funding: \$337,510

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Providing easily accessible, centrally located, USGS biological, water resources, geological, and geospatial datasets for Great Lakes basin restoration activities coordinated with GLOS.

Managers, partners and the public will be able to readily access this information in usable interactive formats to help plan and implement restoration activities. Developing decision support tools such as environmental simulation models that can provide users with the building blocks for modeling efforts such to address, for example, adapting to potential environmental impacts of climate change and stream water quality as related to watershed restoration efforts. Partners include Great Lakes states, EPA, and other federal management agencies.

Milestones

Work with GLRI project Principle Investigators to load and integrate project data into databases and make them easily available on the web.

- Continue to work with other GLRI colleagues to maintain USGS GLRI web presence (<http://cida.usgs.gov/glri/>)
- Make project data discoverable and accessible through USGS GLRI data catalog (<https://cida.usgs.gov/glri/geonetwork>)
- Continue to work with other GLRI projects to develop innovative applications for supporting scientific endeavors as well as communicating science outcomes. Examples include:
 - Environmental Data Discovery and Transformation (EnDDaT) system: In review.
 - SPARROW Model Decision Support System:
http://cida.usgs.gov/sparrow/map.jsp?model=42&session=tp_pcs_zero_maumee
 - Water-Quality Data Access: <http://qwwebservices.usgs.gov/portal.html>

- Access to Real-Time Data: <http://nwisvaws02.er.usgs.gov/ogc-swie/MapFiles/Map.jsp?dataSet=GL>
- Collaborate with other non-USGS GLRI partners to evolve broad data management strategy that includes standardized ways of sharing and using other observed and modeled environmental conditions.

Measures of Progress

5.2 Number of priority LaMP projects that are completed.

Database and decision support tools will contribute to:

Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships: through

Goal 2: The necessary technology and programmatic infrastructure supports monitoring and reporting, through

Objective 10: timely delivery of data and information provided to decision makers at multiple scales within a framework of established baselines, targets, indicators of progress, and monitoring

Collaborative Arrangements

- Collaboration with GLOS and NOAA with the IOOS Regional Association.
- Work with Environment Canada through the Great Lakes GEOSS Testbed.
- Coordinate closely with USGS GLRI LaMP project for web mapping capabilities and USGS GLOS project for real-time data access.

Budget Information

Personnel	\$ 253,150
Fringe Benefits	\$ 63,288
Travel	\$ 2,500
Equipment	\$ 2,500
Contracts	\$ 0
Indirect Costs	\$ 16,072
Total	\$ 337,510

Template 183a - Lake Ontario Cooperative Science and Monitoring Initiative Lower Trophic Level Project

Total funding: \$87,000

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The Lake Ontario food web is perhaps the most severely impacted in all of the Great Lakes and impacts driven by the introduction of non-indigenous species continue to drive large-scale changes today. The invasive species driven food web in Lake Ontario is of stark contrast to the mostly native food web of Lake Superior and provides the endpoint of the continuum of impacts that occurs moving downstream through the other Great Lakes. The contrasts and similarities between lakes will help inform the question of how replacement of native species with invasives alters energy pathways and impacts trophic efficiency. Spatially and temporally rigorous sampling within lakes coupled with standardized methods and syntheses across lakes will allow us to use gradients in food web structure and productivity to explore how nutrient changes at the bottom of the food web impact fish production at the top; how species replacements alter production across trophic levels; and how biologically and environmentally mediated physical changes (e.g., light transmission, temperature change, etc.) alter the food web. Ecosystem models resulting from this work allow managers to explore how future perturbations or management actions influence key trophic responses in Lake Ontario.

Data Collection and analyses:

This study follows EPA's year of intensive sampling around the Great Lakes and complements and expands upon EPA and other partner entities work. In 2013, on Lake Ontario USGS will sample the food web from a nearshore (20 m) to offshore (100 m) gradient where seasonal sampling of primary producers, benthic invertebrates, zooplankton, prey fish, sport fish, and their diets will occur. We will work closely with state management agencies and stakeholder groups to ensure that ecosystem models that emerge from this work explore relevant future management scenarios.

Predator Diet Budget Supplementation:

Work funded by this template will analyze the diets of the six species of trout and salmon currently occurring in Lake Ontario. This predator diet analysis is the key trophic link that integrates lower trophic level productivity with top predator production and sport fishery success. Bridging primary and secondary production to top predators will also inform native species (i.e., lake trout, Atlantic salmon, and deepwater coregonines) restoration.

Milestones

The drastic changes in lower trophic level production that occurred in the upper lakes seem to have also occurred in Lake Ontario. An understanding of these events has been identified by partners across the lake as a priority area for investigation, and will be a key area of focus in our coordinated science monitoring efforts.

Measures of Progress

4.4 Percent of recovery actions implemented for priority listed species.

2.3 Number multi-agency plans established, mock exercises to practice rapid responses carried out under those plans, and/or actual rapid response actions

Understanding the effects of invasive invertebrates and fish on the flow of energy through the food chain is essential in aiding managers with appropriate information for fish restoration efforts. This project is promoting implementation of the GLRI Great Lakes Action Plan as well

as areas of increased emphasis by GLNPO for FY 2012 and FY 2013.

By providing a framework for understanding the effects of changing conditions (nutrients, invasive species), pest management control options, and management concerns (fish restoration), this work supports focus areas 2, 4, and 5 Great Lakes Action Plan.

Focus Area 2: Invasive Species

Goal 5: An effective, efficient and environmentally sound program of integrated pest management for invasive species is developed and implemented, including program function of containment, eradication, control and mitigation.

Measure 3. Will provide models to determine effectiveness of control plans.

Focus Area 4: Habitat and Wildlife Protection and Restoration.

Goal 1: Protection and restoration of Great Lakes aquatic and terrestrial habitats, including physical, chemical, and biological processes and ecosystem functions, maintain or improve the conditions of native fish and wildlife.

Goal 3: Sound decision making is facilitated by accessible, site specific and landscape-scale baseline status and trend information about fish and wildlife resources and their habitats.

Measure 4. Will provide information for recovery action plans.

Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships:

Goal 1. A cooperative monitoring and observing system provides a comprehensive assessment of the Great lakes ecosystem. To help meet:

Objective 10: provide timely data and information to decision makers.

Collaborative Arrangements

This study is a multi-agency endeavor that includes state, federal, provincial, and tribal entities involved in the lake. These include:

US EPA, US Fish and Wildlife Service, Illinois Department of Natural Resources, Indiana Department of Natural Resources, Michigan Department of Natural Resources, Minnesota Department of Natural Resources, New York State Department of Environmental Conservation, Ohio Department of Natural Resources, Pennsylvania Fish and Boat Commission, Wisconsin Department of Natural Resources, Chippewa-Ottawa Resource Authority, Great Lakes Indian Fish & Wildlife Commission, Ontario Ministry of Natural Resources, Department of Fisheries and Oceans Canada, and Environment Canada.

Budget Information

Personnel	\$ 61,987
Fringe Benefits	\$ 20,663
Travel	\$ 0
Equipment	\$ 0
Contracts	\$ 0
Indirect Costs	\$ 4,350
Total	\$ 87,000

Template 183b - Understanding Nutrient Loading Impacts on Lake Ontario Nearshore Waters

Total funding: \$363,910

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The Great Lakes ecosystem has undergone major changes over the last two decades related to the invasion of Dreissenid mussels, increased water clarity, increased benthic algae and associated water quality problems. For reasons not yet entirely understood, and that have bi-national significance, water column total phosphorus has not significantly increased over the last decade but the relative percent of the more biologically available dissolved phosphorus has increased. The filtering action of Dreissenid mussels has been shown to increase concentrations of dissolved phosphorus in the water column immediately above mussel beds and this had been hypothesized as one explanation for the increase of benthic algae. However, the Lake Ontario 2008 CSMI monitoring year's assessment of nearshore water eutrophication problems concluded that localized eutrophication problems could not be explained by the presence of mussel beds alone. Tributary nutrient inputs always appeared to be a common factor related to localized nearshore problems. This work will expand the nearshore work begun in 2008, as part of a binational assessment coordinated by the Lake Ontario Lakewide Management Plan, to develop better understand the connection between tributary nutrient inputs and Lake Ontario nearshore water quality and nutrient fate and transport with the aim of identifying potential management actions. This nearshore work will complement offshore work to be coordinated by US and Canadian Lake Ontario Lakewide Management Plan partners through the use of the research vessels *Lake Guardian* and *Limnos*.

The maintenance of flow gaging systems and regular monitoring programs are essential to understand nutrient loadings and impacts. This work will allow the maintenance of gaging stations and the collection of nutrient samples from six major, and several selected minor New York Lake Ontario tributaries through the 2014 field year. Included will be the GLRI priority watershed, the Genesee River, and Oak Orchard Creek, both identified as large nutrient loading basins to the southern shore of Lake Ontario. In addition to seven regularly scheduled sampling events for each tributary, the sampling plan will be designed to capture spring, growing season and extreme flow events with a focus on understanding particulate and dissolved nutrient concentrations and loadings. This work will be in addition to the work being conducted for template 76 at the Genesee River. This information will be of tremendous value in supporting the development of nutrient loading estimates and for the development of nutrient fate and transport models coincident with the new bi-national Great Lakes Water Quality agreement protocol

Studies of water quality and the lower foodweb at selected nearshore zones impacted by tributary inputs will be designed to better understand the fate and transport of nutrients in the water column and aquatic foodweb and the connection with the health of nearshore aquatic

communities and local beaches along the Lake Ontario shoreline. Timing of nearshore sampling events will be coordinated with tributary monitoring. Both tributary and nearshore monitoring and research activities will place an emphasis on developing a better understanding of dissolved and total phosphorus ratios and whether different ratios drive varying biological responses.

All of this work will be coordinated with a range of US and Canadian Lake Ontario nutrient related work being conducted in 2013 in order to develop a basin-wide assessment of nutrient loadings, fate and transport and the identification of potential management strategies and research in support of the Lake Ontario Lakewide Management Plan (LaMP). A review of currently on-going, and soon-to-be completed, nutrient-related studies, including fate and transport and the response of biological systems, will be included as part of initial planning workshops and factored into the final nearshore project design.

Milestones

USGS will participate in a series of Lake Ontario LaMP workshops and discussions during the Fall 2012 to identify strategies to assess nearshore nutrient loading. The workshops and discussions will be held with the support of the International Joint Commission's Council of Great Lakes Research Managers to develop harmonized approaches to nutrient sampling and understanding nutrient fate and transport to be used by US and Canadian LaMP partners in 2013.

The USGS will facilitate coordination with the NYS DEC and GLNPO to assemble a detailed project plan by January 2013 that will address the logistics and protocol for assessing the nearshore nutrient loading.

Vital water-quality nutrient information for six major tributaries including the Genesee River and its embayment, and several selected minor, New York tributaries to Lake Ontario collected in 2013 and 2014 that will help measure the progress of reducing average annual loadings to Lake Ontario..

Field studies of tributary impacts on selected Lake Ontario nearshore water quality and biota and related nutrient fate and transport mechanisms completed in 2013.

A final report on tributary monitoring and nearshore study results will include research findings, recommendations and management implications to address adaptive strategies that will affect management implications

An effective plan to coordinate US and Canadian 2013 Lake Ontario nutrient related work is completed by spring 2013 in collaboration with LaMP partners. Workshop discussions will identify ways that various US and Canadian nutrient sampling, research and monitoring approaches can be harmonized so that 2013 results can be more easily combined into a basin-wide assessment of nutrient loadings and impacts to be summarized in a LaMP report. These findings will further the assessment of the measures in the GLRI Action Plan to reduce the average annual loading of soluble reactive phosphorus (SRP).

High quality water quality nutrient information is collected from major New York Lake Ontario tributaries. In addition to regularly scheduled events, monitoring effectively captures Spring, growing season and high flow events that are critical to developing a more complete understanding of seasonal patterns of nutrient loadings and any seasonal changes in the relative amounts of total and dissolved nutrients. This will allow comparison of 5-year average annual loading rates of both sediment and nutrients that will address targeted watersheds such as the Genesee River and its embayment.

Studies of Lake Ontario tributary impacts on nearshore water quality provide insights on how nearshore waters respond to tributary nutrient inputs, identify water quality and biological impairments and develop an improved understanding of nutrient fate and transport in the nearshore zone and the aquatic food web. Studies also provide insights on monitoring approaches best suited to characterize nutrient related water quality problems.

Existing nutrient loading models are updated to provide improved nutrient loading estimates.

Measures of Progress

5.2 Number of priority LaMP projects that are completed.

3.1 Five year average annual loadings of soluble reactive phosphorus from tributaries draining targeted watersheds

This work will be essential to achieving a number of Great Lakes Restoration Action Plan objectives for Focus Area 3, Nearshore Health and NonPoint Source Pollution, including:

- *By 2014, a baseline will be established for total suspended solids loadings from targeted tributaries.* This work will collect the water quality data needed to develop baseline total suspended solids loadings from key Lake Ontario tributaries.
- *By 2014, a measurable decrease will be achieved in soluble phosphorus loading from 2008 levels in targeted tributaries.* This work will develop a comprehensive characterization of soluble phosphorus loadings from which future reductions can be measured.
- *By 2014, the causes of nutrient-related nearshore biological impairments will be better understood.* The nearshore monitoring and research will seek to understand the fate and transport mechanisms that are related to nearshore water quality problems.
- *By 2014, a comprehensive nearshore monitoring program will have been established and implemented, including a publicly accessible reporting system, based on a suite of environmental indicators.* The collaborative working relationships to be formed with New York State and academic institutions in conducting the nearshore monitoring and research component of this project will help define cost effective approaches for instituting a nearshore monitoring program.

As well as in support of objectives for Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships, including:

Goal 1. A cooperative monitoring and observing system provides a comprehensive assessment of the Great lakes ecosystem. And

Goal 5: Work under the goals and objectives of the Great Lakes Water Quality Agreement is coordinated between the U.S. and Canada through Lakewide Management Plans (LaMP) and other binational processes,

Objective 8: improved coordination with Canada will take place for programs under the Great Lakes Water Quality Agreement, particularly under the LaMPs, which will result in the achievement of 5-10 priority LaMP goals and actions.

Objective 9: a comprehensive assessment of Great Lakes water resources that include monitoring and observing efforts. And

Objective 10: provide timely data and information to decision makers.

Collaborative Arrangements

Work will be coordinated to the maximum extent possible with other nutrient work to be conducted by Lake Ontario Lakewide Management Plan partners in 2013 in order to contribute to a basin-wide assessment of nutrient loading impacts to Lake Ontario's nearshore waters. Initial binational workshop discussions on nutrient monitoring and research approaches will be sponsored by the International Joint Commission's Council of Great Lakes Research Managers. The detailed work plan will be developed in consultation with New York State Department of Environmental Conservation (NYSDEC) to ensure that sampling and research results will contribute to NYSDEC's water quality information and research needs.

The Lake Ontario LaMP is coordinating an assessment of water quality nutrient concentration and the status of the lower for the open waters of Lake Ontario through the use of large research vessels such as EPA's R/V *Lake Guardian* and the Canadian Coast Guard's R/V *Limnos*. Taken together these two efforts will provide an improved understanding of nutrient fate and transport from the watersheds, through nearshore to the open waters of Lake Ontario.

Budget Information

Personnel	\$ 85,826
Fringe Benefits	\$ 17,537
Travel	\$ 5,519
Equipment	\$ 22,273
Contracts	\$ 200,000
Lab Analyses	\$ 15,881
Indirect Costs	\$ 16,874
Total	\$ 363,910

Template 330 - Lake-Wide Management Plan Capacity Support by USGS (LaMP)

Total funding: \$318,100

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The USGS-LaMP objectives include:

- Providing USGS expertise, capacity, and support for Great Lakes programs
- Participating in LaMP processes, programs, conferences, workshops and projects, including the development of LaMP documents and updates
- Serving on work groups and technical committees
- Participating in interagency actions that implement LaMP programs and priorities
- Incorporating LaMP goals into USGS planning efforts

LaMP efforts include compiling monitoring information into the Great Lakes web mapper (Mapper) and support of summary publications describing the status of monitoring data for each lake. The Mapper's focus is on compilation of information that will result in recognition of areas where data are being collected, missing or sparse, and on areas where ecosystems are vulnerable. The Mapper will assist decision-making for protecting and restoring Great Lake ecosystems.

Activities of individual USGS Science Centers include coordinating with partners in each of the Great Lakes and support of sampling and monitoring activities.

- For Lake Huron, emphasis is on issues affecting fisheries and nutrient inputs, particularly in the Saginaw basin, and on the development of the Mapper to assist partners in making management decisions.
- For Lake Superior, emphasis is on support of activities with partners in compiling and collecting data focused on Areas of Concern, nutrients, and impacts from potential metal mining.
- Lake Michigan efforts include continued compilation of monitoring information into the Mapper and support of a near-shore monitoring and framework white paper.
- For Lake Erie, emphasis is on coordinating activities with partners and on compiling data for the Mapper.
- For Lake Ontario, work consists of coordinating activities with the EPA for de-listing projects at Areas of Concern. Activities of the Great Lakes Science Centers include coordinating with partners in each of the Great Lakes and on support for near-shore sampling and monitoring activities.

Milestones

Emphasis has been placed on construction of the Great Lakes web mapper (Mapper) to support the needs of individual lakes and for the entire Great Lakes basin. Data on the release of toxic substances to the Great Lakes are being evaluated. These data include current levels of toxic substances so that future exposure to toxic substances, from historically contaminated sources, can be reduced through source reduction and other exposure-reduction methods. Data will help to protect near-shore ecosystem health and aid management decisions. Land-use information is provided to ensure that near-shore aquatic, wetland, and upland habitats can sustain the health and function of natural communities. Data on loading of sediments, nutrients and pollutants to tributaries are being compiled. USGS data on sediment loading are used to determine whether reductions can be achieved. Site-specific and landscape-scale baseline data about aquatic resources are being compiled to aid in management decisions. This effort can provide broad-scale baseline-trend information needed to make sound decisions.

Data are evaluated about the release of toxic substances to Areas of Concern and to aid in the reduction of toxic loading to the Great Lakes. This effort includes providing current levels of

toxic substances to help reduce future exposure to toxic substances from historically contaminated sources through source reduction and other exposure reduction methods.

Information about the health of watersheds is provided to aid in management decisions that will assist protection of near-shore health. Land-use information is used for management decisions to ensure that near-shore aquatic, wetland, and upland habitats can sustain the health and function of natural communities. Information about loading of sediments, nutrients and pollutants to tributaries is provided to determine whether reductions of these potentially harmful constituents can be achieved.

Site-specific and landscape-scale baseline status and trend information about aquatic resources are provided to aid management decisions. Preliminary data on stream sediments in three Lake Superior watersheds with on-going exploration or development for metal mining indicate broad differences in baseline metal values across the region. This supports the need for regional baseline studies in Great Lake basins with high potential for metal mining (i.e., Lake Superior and Lake Michigan). Assessments of high-priority actions, identified in strategic plans (such as state and federal species management, restoration and recovery plans, Lakewide Management Plans, Remedial Action Plans, and others) are provided to assist in the achievement of goals for the Lakes.

Measures of Progress

5.2 Number of priority LaMP projects that are completed.

In support of objectives for Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships, including:

Goal 5: Work under the goals and objectives of the Great Lakes Water Quality Agreement is coordinated between the U.S. and Canada through Lakewide Management Plans (LaMP) and other binational processes,

Objective 8: improved coordination with Canada will take place for programs under the Great Lakes Water Quality Agreement, particularly under the LaMPs, which will result in the achievement of 5-10 priority LaMP goals and actions.

Objective 10: provide timely data and information to decision makers.

Collaborative Arrangements

LaMP efforts include coordination with tribal natural resources departments, the USEPA, and State agencies. Scientists work closely with partners to assure that products and results are applicable and useful.

Budget Information

Personnel	\$ 192,700
Fringe Benefits	\$ 79,500
Travel	\$ 30,000
Equipment	\$ 0
Contracts	\$ 0
Indirect Costs	\$ 15,900
Total	\$ 318,100

Template 332 - Implementation of the Great Lakes Observing System

Total funding: \$506,261

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

This project will provide direct support for Great Lakes Observing System (GLOS) Department of Interior backbone activities within the Midwest Area office of the U.S. Geological Survey, including:

- The deployment and support of observation platforms;
- Water-quality statistical models to link constituents in laboratory-analyzed samples with in-stream continuous-sensor measurements;
- Watershed models to better assess sources and sinks of nutrient contamination, including:
 - HSPF models for the Saginaw and Tonawanda watersheds will provide a framework for evaluating hydrology and water-quality loading for sediment and other water-quality parameters for the two basins. Parameters developed for these models will be transferrable to other watersheds within the Great Lakes with similar hydrogeologic characteristics;
 - Top model and WATER model development for the Great Lakes; and
 - Hydrosparrow modeling to determine land use and climate change impacts on water-quality;
- Information system infrastructure development and implementation to provide a data platform to support real-time decision support needs, including:
 - Participation in the Great Lakes Testbed of GEOSS (Global Earth Observation System of Systems) provides linkages to similar data from Canadian agencies;
 - Development of a Decision Support System that leverages the GLOS Data Network. Initial focus for DSS is on nutrient fluxes to key tributaries around the Great Lakes. The System will aid in AOC delisting by providing access to consistent monitoring data with broad spatial coverage necessary for understanding whether nutrient reduction goals have been met; and
 - A tool called EnDDaT is being developed with the GLRI Beaches project to integrate real-time data relevant for beach and other nearshore modeling.

Milestones

- Continue to work with NOAA and GLOS to make additional Great Lakes datasets accessible according to IOOS standards as described in the GLOS Enterprise Architecture study.
- Launch Environmental Data Discovery and Transformation (EnDDaT) tool to integrate real-time data relevant for beach and other nearshore modeling.
- Continue to support and acquire and test equipment needed to develop near-real-time estimates of analytes including wastewater-related compounds and mercury.
- Develop water-quality statistical models of surrogate relationships and time series estimates of loads in support of nearshore and toxic chemical GLRI projects.

- HydroSPARROW - The framework (computer code) has been completed integrating the SPARROW model with TopModel and WATER models; Effects of Land Use Changes on nutrient inputs have been estimated but need to be quality assured; Preliminary changes in streamflow have been estimated.
- HSPF Models of Kalamazoo River (MI) and Tonawanda Cr. (NY) - Kalamazoo River Basin (hydrologic component) has been developed (but not yet calibrated) included in model development are 13 dam structures, and improve channel thalweg estimation; parameter estimation code has been set up for calibration of the model; 3) sediment components have been included and results evaluated; the hydrologic component for the Tonawanda model is in development.

Measures of Progress

5.2 Number of priority LaMP projects that are completed.

5.3 Number of educational institutions incorporating new or existing Great Lakes protection and stewardship criteria into their broader environment education curricula.

1.2 Area of Concern Beneficial Use Impairments removed

The Great Lakes Observing System coordinates and integrates regional coastal observations supporting national & regional priorities including Great Lakes restoration. The DOI backbone project provides instrumentation and testing of new technologies for real-time observing system information in tributaries, embayments, and the near-shore to determine and guide restoration activities. This includes: monitoring to provide a direct measure of soluble reactive phosphorus concentrations, provide information for BUI removal and for assessing emerging threats; and a coordinated approach to making this information available to decision makers.

In support of objectives for Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships, including:

Goal 1. A cooperative monitoring and observing system provides a comprehensive assessment of the Great lakes ecosystem. And

Objective 9: a comprehensive assessment of Great Lakes water resources that include monitoring and observing efforts. And

Objective 10: provide timely data and information to decision makers.

Collaborative Arrangements

Data management is coordinated with partners including NOAA, EPA and USACE through the Great Lakes Observing System. A multi-agency Enterprise Architecture design has been completed and work continues to integrate USGS sensor networks with GLOS through the use of international standards.

A governing board chaired by GLNPO or a cross section of federal agencies would be helpful in coordinating the overall GLOS activity within GLRI.

Budget Information

Personnel	\$ 320,961
Fringe Benefits	\$ 106,987
Travel	\$ 3,000

Equipment	\$ 50,000
Contracts	\$ 0
Cooperative Agreements	\$ 0
Indirect Costs	\$ 25,313
Total	\$ 506,261

Template 588a - Forecasting Great Lakes Basin Responses to Future Change

Total funding: \$142,505

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

The purpose of this template is to provide insight into the long-term viability of present day restoration investments given expectations of land use and climate change. Such work helps ensure that public and other funds are not directed to restoration projects unlikely to be self-sufficient and viable over societally relevant time scales.

This objective is met by constructing and calibrating a watershed hydrologic model of the Lake Superior Basin suitable for accepting downscaled climate change inputs from a variety of federal and non-federal stakeholders. The model forecasts of future hydrologic flows are vital for restoration, water quantity, water quality, infrastructure, habitat, and other ecological decision making. The work leverages the best current existing data sources into model input (temperature, precipitation), parameterization (soils, slope, etc.), and calibration targets (measured streamflows). The first work element below is similar to FY 2011 proposed work, which reflects the extension of work across fiscal years due to previous reductions in funding. Specific FY 2012 GLRI Template 588 work elements would consist of:

1. Construct and calibrate a refined NHM/PRMS model of the LSB using historical streamflow records,
2. Simulate current and potential future land use and climate change, and demonstrate the suitability for forecasting hydrologic effects of change.
3. Link the hydrologic flows to other GLRI funded restoration endpoints: a) forecasts of mercury in Great Lakes fish (collaboration with State of Minnesota and Canada); and b) hindcast and forecasts of flow and temperature effects on Great Lakes tributary spawning (collaboration with University of Wisconsin-Madison Center for Limnology).

Milestones

1. Lake Superior Basin hydrologic numerical model calibrated to current conditions; May 2012
2. Three scenarios from four GCMs downscaled and run as input to provide 12 climate change scenario examples using the calibrated PRMS model; June 2012
3. USGS Scientific Investigation Report documenting the model and climate scenarios run; October 2012

4. Link forecasts of hydrologic flows to other GLRI restoration endpoints; July-September 2012

Measures of Progress

5.2 Number of priority LaMP projects that are completed.

3.1 Five year average annual loadings of soluble reactive phosphorus from tributaries draining targeted watersheds

Supports Focus Area 4: Habitat and Wildlife Protection and Restoration Goals 3 and 4:

Template objectives and deliverables facilitate more timely data and information assimilation and processing, which in turn is delivered in a form that provides a science-based foundation to decision makers. These deliverables cover multiple scales within a framework that leverages established baselines, targets, indicators of progress, and monitoring.

In support of objectives for Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships, including:

Goal 1. A cooperative monitoring and observing system provides a comprehensive assessment of the Great lakes ecosystem. And

Objective 10: provide timely data and information to decision makers.

Collaborative Arrangements

This work benefits from collaboration with NOAA Great Lakes Science Center (Andrew Gronewold), the State of Minnesota mercury in fish GLRI project (Dan Engstrom/Reed Harris PIs), and the University of Wisconsin-Madison Center for Limnology Great Lakes Fish Project (Dr. Peter McIntyre PI).

Budget Information

Personnel	\$ 45,868
Benefits	\$ 15,289
Travel	\$ 2,000
Contracts	\$ 72,223
Indirect Costs:	\$ 7,125
Total Costs:	\$ 142,505

Template 588b - Forecasting Potential *Phragmites* Coastal Invasion Corridors

Total funding: \$110,625

Authority for work: USGS Organic Act 43 U.S.C. 31 and General Cooperation Authority 43 U.S.C. 36c

Description of Work

Alterations to the Great Lakes shoreline or water-level patterns associated with global climate change could have significant impacts on the extent and composition of coastal habitat. Low lake levels can expose fertile wetland bottomlands to invasive species such as common reed

(*Phragmites*). USGS will use remote-sensing data to establish a baseline understanding of current distributions of invasive wetland plants and then forecast potential invasion corridors.

A map of the current *Phragmites* distribution along the US Great Lakes coastal zone (10-km buffer inland from shore) will be generated and published as a management decision-support tool. This map can be used to understand the large-scale factors influencing *Phragmites* distribution, such as, but not limited to, nutrient loading to the coastal zone, proximity to urban and agricultural land-use types, shoreline development, slope and topography, and water depth. The major influencing factors will be used to develop a GIS modeling framework to identify areas vulnerable to invasion by *Phragmites*.

Data and information collected from on-the-ground monitoring efforts associated with *Phragmites*-control or habitat restoration projects are not being coordinated among projects and communicated regionally, resulting in missed opportunities to learn from actions on the landscape. Similarly, updates on the development of new sustainable management strategies (e.g., biocontrol, endophytic fungi, gene silencing, allelopathic processes) do not easily permeate the local and regional decision-making process. USGS will work with the Great Lakes Commission (GLC) to build a framework to harness partner data and synthesize knowledge gained during *Phragmites* control and restoration projects. Many partners will be engaged including the Southeast Michigan Council of Governments (SEMCOG), Army Corps of Engineers, The Nature Conservancy, and U.S. Fish and Wildlife Service.

Milestones

1. Complete ground-truthing to iteratively improve *Phragmites* maps, December 2011
2. Finalize the first version of *Phragmites* maps for all five lakes, December 2011
3. Complete species distribution analyses and vulnerability assessment, February 2012
4. Peer review data maps and interpretations, April 2012.
5. Establish a project management team for framework development, April 2012
6. Model the potential spread of *Phragmites* given various future climate scenarios, June 2012
7. Develop an interactive management system to employ results effectively, June 2012
8. Highlight protocols for data collection and aggregation during and after management actions, August 2012
9. Participate in local, regional, and other forums to assess needs of data users and provide planning and assistance with data collection and analysis, September 2012
10. Communicate project results to the public and decision makers through presentations, web pages, fact sheets, and peer-reviewed manuscripts, September 2012

Measures of Progress

- 5.2 Number of priority LaMP projects that are completed.
- 2.4 Number of recreation and resource users (in millions) contacted on best practices that prevent the introduction and spread of invasive species
- 4.6 Number of acres of wetlands and wetland-associated uplands protected, restored and enhanced

This project is promoting implementation of the GLRI Great Lakes Action Plan as well as areas

of increased emphasis by GLNPO for FY 2012 and FY 2013. It supports objectives and measures related to more timely data and information provided to decision makers at multiple scales within a framework of established baselines, targets, indicators of progress, and monitoring.

This project addresses GLRI action plan Focus Area 2 (Invasive Species) by providing a basin-wide program for detection and tracking of invasive species in the Great Lakes and providing up-to-date critical information needed by decision makers for evaluating potential rapid response actions. It also addresses action plan Focus Area 4 (Habitat and Wildlife) by supporting protection and restoration of habitat and providing landscape-scale information on aquatic habitat.

Great Lakes Action Plan

Focus Area 2: Invasive Species

Goal 4: A comprehensive program for detection and tracking newly identified invasive species in the Great Lakes is developed and provides up-to-date critical information needed by decision makers for evaluating potential rapid response actions.

Measure 2. Will provide information to most effectively manage land for invasive species control.

Focus Area 4: Habitat and Wildlife Protection and Restoration.

Goal 1: Protection and restoration of Great Lakes aquatic and terrestrial habitats, including physical, chemical, and biological processes and ecosystem functions, maintain or improve the conditions of native fish and wildlife.

Goal 3: Sound decision making is facilitated by accessible, site specific and landscape-scale baseline status and trend information about fish and wildlife resources and their habitats.

Goal 4: High priority actions identified in strategic plans are implemented, lead to the achievement of plan goals, and reduce the loss of fish and wildlife and their habitats.

Measure 6. Will provide information for protecting wetlands.

In support of objectives for Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships, including:

Goal 1. A cooperative monitoring and observing system provides a comprehensive assessment of the Great lakes ecosystem. And

Objective 10: provide timely data and information to decision makers.

This project also supports recent EPA priorities on invasive species and AOCs. *Phragmites* is a highly visible and destructive invasive wetland plant species that is the focus of significant management and control efforts, including those associated with ongoing GLRI restoration projects. Data and information collected from monitoring efforts are not being coordinated among projects and communicated regionally, resulting in missed opportunities to learn from actions on the landscape and a breakdown in the integrated pest management strategy. This project is working to improve the process, resulting in system-wide benefits. Since *Phragmites* is a common problem in AOCs, the results of this work should contribute to restoration efforts and the BUI delisting process.

Collaborative Arrangements

USGS Great Lakes Science Center will continue to collaborate with Boston College staff for data analysis and interpretation, the USGS Center for Integrated Data Analytics for development of the decision support tool, and the USGS Wisconsin Water Science Center for nutrient data used during modeling.

Partnerships were developed with several other organizations:

1. Michigan Tech Research Institute
2. US Army Corps of Engineers (LIDAR data)
3. NOAA Coastal Services Center (LIDAR data)
4. Alaska Satellite Facility (PALSAR data)
5. US Fish and Wildlife Service (Additional GLRI funds)

Finally, a multiagency partnership (USGS-GLSC, Great Lakes Commission, and SEMCOG) is being developed for this project that will help the planned coordination be both regionally applicable and locally significant.

Budget Information

Personnel	\$ 27,109
Fringe Benefits	\$ 9,036
Travel	\$ 5,000
Equipment	\$ 3,949
Contracts	\$ 60,000
Cooperative Agreements	\$ 0
Indirect Costs	\$ 5,531
Total	\$ 110,625

GREY AREAS WILL AUTOMATICALLY CALCULATE TOTALS

Template Number	Template Name	Personnel	Fringe Benefits	Travel	Equipment	Other	Grants	Contracts	Procurement/ Assistance*	Sub-Total	Indirect Cost	Total	Indirect Cost Rates
78	Determine Baseline and Sources of Toxic Contaminant Loadings	\$ 153,883	\$ 51,294	\$ 10,000		\$ 5,000		\$ 300,850	\$ 300,850	\$ 521,027	\$ 27,422	\$ 548,449	5.00%
79	Mercury Cycling and Bioaccumulation in the Great Lakes	\$ 97,707	\$ 32,569	\$ 5,000		\$ 5,000				\$ 140,276	\$ 7,383	\$ 147,659	5.00%
80	Birds as Indicators of Contaminant Exposure in the Great Lakes	\$ 85,779	\$ 24,194	\$ 10,000	\$ 2,000			\$ 320,000	\$ 320,000	\$ 441,973	\$ 22,099	\$ 464,072	4.76%
146a	Riparian Indicators of Contaminant Exposure in AOCs							\$ 66,500	\$ 66,500	\$ 66,500	\$ 3,500	\$ 70,000	5.00%
146b	Sediment Toxicity and Status of Benthic Invertebrate Communities in the Rochester Embayment Area of Concern	\$ 54,381	\$ 6,109	\$ 3,864	\$ 2,147					\$ 66,501	\$ 3,499	\$ 70,000	5.00%
146c	Sediment Toxicity and Status of Benthic Invertebrate Communities in the St. Lawrence River and its Tributaries within the Massena Area of Concern	\$ 27,490	\$ 9,163	\$ 2,898	\$ 3,220					\$ 42,771	\$ 2,251	\$ 45,022	5.00%
146d	Determining sources of bacterial contamination at Jearse Park Beach, in the Grand Calumet River AOC	\$ 9,600	\$ 2,400	\$ 2,000	\$ 7,000			\$ 55,000	\$ 55,000	\$ 76,000	\$ 4,000	\$ 80,000	5.00%
147	Development of Critical Information	\$ 264,027	\$ 113,154	\$ 4,000				\$ 87,169	\$ 87,169	\$ 468,360	\$ 24,650	\$ 493,000	5.00%
370	Riparian Indicators of Contaminant Exposure to Support Delisting of AOCs and Removal of Beneficial Use Impairments	\$ 79,000	\$ 19,000	\$ 20,000		\$ 23,000		\$ 96,500	\$ 96,500	\$ 237,500	\$ 12,500	\$ 250,000	5.00%
384	USGS support for AOC Delisting (Decision Support for BUI removal)	\$ 86,428	\$ 28,809	\$ 5,000						\$ 120,237	\$ 6,328	\$ 126,565	5.00%
	Sub-total	\$ 858,295	\$ 286,692	\$ 62,762	\$ 14,367	\$ 33,000	\$ -	\$ 926,019	\$ 926,019	\$ 2,181,135	\$ 113,632	\$ 2,294,767	4.98%

[illegible]

Focus Area 3: Nearshore Health and Nonpoint Source Pollution

Focus Area 4: Habitat and Wildlife Protection

[illegible]

Great Lakes Restoration Initiative

Project Funding Summary Spreadsheet

FY 2012
7/5/2012

Focus Area 5: Accountability, Education, Monitoring, Evaluation, Communication and Partnership

Template Number	Template Name	Personnel	Fringe Benefits	Travel	Equipment	Other	Grants	Contracts	Procurement/ Assistance	Sub-Total	Indirect Cost	Total	Indirect Cost Rates
81	Watershed Modeling for Stream Ecosystem Management	\$ 300,916	\$ 84,874	\$ 15,000					\$	\$ 400,790	\$ 21,094	\$ 421,884	5.00%
82	Characterizing Habitat and Food Web Structures across Great Lakes Estuaries	\$ 94,794	\$ 23,698	\$ 33,715		\$ 6,485		\$ 42,205	\$ 42,205	\$ 200,897	\$ 10,045	\$ 210,942	4.76%
84	USGS GLRI Database	\$ 253,150	\$ 63,288	\$ 2,500	\$ 2,500				\$	\$ 321,438	\$ 16,072	\$ 337,510	4.76%
183a	Lake Ontario CSMI Lower Trophic Level Project	\$ 61,987	\$ 20,663						\$	\$ 82,650	\$ 4,350	\$ 87,000	5.00%
183b	Understanding Nutrient Loading Impacts on Lake Ontario Nearshore Waters	\$ 85,826	\$ 17,537	\$ 5,519	\$ 22,273	\$ 15,881		\$ 200,000	\$ 200,000	\$ 347,036	\$ 16,874	\$ 363,910	4.64%
330	Lake-Wide Management Plan Capacity Support by USGS (LaMP)	\$ 192,700	\$ 79,500	\$ 30,000					\$	\$ 302,200	\$ 15,900	\$ 318,100	5.00%
332	Implementation of the Great Lakes Observing System	\$ 320,961	\$ 108,987	\$ 3,000	\$ 50,000				\$	\$ 480,948	\$ 25,313	\$ 506,261	5.00%
588a	Forecasting Great Lakes Basin Responses to Future Change	\$ 45,868	\$ 15,289	\$ 2,000				\$ 72,223	\$ 72,223	\$ 135,380	\$ 7,125	\$ 142,505	5.00%
588b	Forecasting Potential Phragmites Coastal Invasion Corridors	\$ 27,109	\$ 9,036	\$ 5,000	\$ 3,949			\$ 60,000	\$ 60,000	\$ 105,094	\$ 5,531	\$ 110,625	5.00%
									\$	\$		\$	
									\$	\$		\$	
									\$	\$		\$	
	Sub-total	\$ 1,383,311	\$ 420,872	\$ 96,734	\$ 78,722	\$ 22,366	\$ -	\$ 374,428	\$ 374,428	\$ 2,376,433	\$ 122,304	\$ 2,498,737	4.91%

AWARD TOTAL	\$ 4,505,784	\$ 1,317,498	\$ 730,918	\$ 850,288	\$ 137,366	\$ -	\$ 4,275,143	\$ 4,275,143	\$ 11,816,997	\$ 614,964	\$ 12,431,961
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